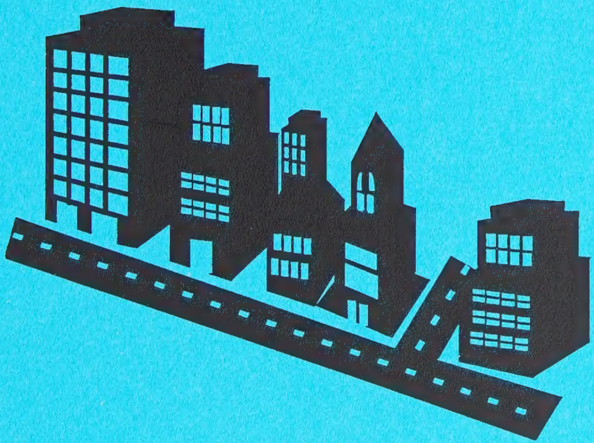
BAAQMD CEQA GUIDELINES

Assessing the Air Quality Impacts of Projects and Plans



April 1996

Bay Area Air Quality Management District
939 Ellis Street San Francisco, CA 94109

BAAQMD CEQA GUIDELINES
Assessing the Air Quality Impacts of Projects and Plans

Prepared by the Planning and Research Division of the
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

April, 1996

This document is intended to serve as a guide for those who prepare or evaluate air quality impact analyses for projects and plans in the San Francisco Bay Area. The GUIDELINES include information on legal requirements, BAAQMD rules, plans and procedures, methods of analyzing air quality impacts, thresholds of significance, mitigation measures, and background air quality information. Copies and updates are available from the BAAQMD Public Information Office at (415) 749-4900. Questions on content may be addressed to the BAAQMD's Planning and Transportation Section at (415) 749-4995.

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The authors also wish to thank Lilia Martinez and Judith Williams, who provided the word processing for this document.

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CHAPTER 1 - INTRODUCTION

1.1 Background

The purpose of these Guidelines is to assist Lead Agencies, as well as consultants, project proponents and other interested parties, in evaluating potential air quality impacts of projects and plans proposed in the San Francisco Bay Area. Specifically, these Guidelines explain the procedures that the Bay Area Air Quality Management District (BAAQMD or "District") recommends be followed during environmental review processes required by the California Environmental Quality Act (CEQA). The Guidelines provide direction on how to evaluate potential air quality impacts, how to determine whether these impacts are significant, and how to mitigate these impacts. It is hoped that by providing this guidance, the air quality impacts of plans and development proposals will be analyzed accurately and consistently, and adverse impacts will be minimized.

These guidelines do not attempt to address every type of project that may be subject to CEQA analysis. Greatest emphasis is placed on: development proposals, such as commercial or residential projects, that generate significant numbers of vehicle trips (and associated air pollutant emissions); impacts related to nuisances (such as odors and dust), toxic air contaminants and accidental releases of hazardous materials, often resulting from air pollutant sources and members of the public being in close proximity; and preparation or revision of plans, such as general plans or specific plans.

1.2 How to Use These Guidelines

This document replaces the District's previous CEQA guidance document, *Air Quality and Urban Development: Guidelines for Assessing Impacts of Projects and Plans*, published in November 1985 (with revisions through August 1991). This 1996 document has more current information regarding issues including federal and State requirements, regional air quality plans, emission inventories, analytical procedures and mitigation strategies. Some of the more significant additions or revisions in this document include the following:

- Recommendations regarding early consultation procedures between Lead Agencies and project proponents on issues such as land use and design measures to reduce auto use, land use conflicts and sensitive receptors, and District regulatory requirements. (See pages 8-10.)

- Thresholds of significance for impacts associated with construction, project operations, odors, toxics, accidental releases, cumulative impacts, and plans. (See pages 12-24.)

- Calculating mobile source emissions using the URBEMIS model. (See pages 30-32.)

- Determining background carbon monoxide (CO) concentrations for use in microscale CO modeling. (See pages 41-46.)

- Mitigating air quality impacts through land use and design measures. (See pages 8-9, 53-56.)

The recommendations in these Guidelines should be viewed as minimum considerations for air quality analysis. A Lead Agency or a project proponent may substitute more sophisticated models, more precise input data, innovative mitigation measures and/or other features. The District encourages creative approaches to impact analysis and mitigation in planning for air quality improvement.

Portions of these Guidelines will be revised as new information becomes available on such matters as revised emission factors for the Bay Area motor vehicle fleet or emission inventories. Copies and updates of these Guidelines are available from the District's Public Information Office at (415) 749-4900. Questions on content may be addressed to the District's Planning and Transportation Section at (415) 749-4995.

Organization of the Guidelines

Chapter 1 provides a summary of the purpose of the document, a brief overview of District responsibilities, and summary information regarding air pollution in the Bay Area.

Chapter 2 suggests early consultation procedures and issues for consideration by Lead Agencies, discusses preparation of the Initial Study, and provides thresholds of significance for determining whether an air quality impact is significant.

Chapter 3 describes methods for estimating air quality impacts. The chapter addresses impacts from project construction, project operations, and plans.

Chapter 4 describes methods for mitigating air quality impacts. The chapter discusses mitigation strategies to be considered at the general plan level, and project-specific mitigation measures.

Appendix A discusses laws, regulations, programs and plans related to air quality management.

Appendix B summarizes sources and effects of air pollutants.

Appendix C summarizes the region's attainment status with respect to national and State air quality standards, and discusses air quality problems and trends.

Appendix D discusses how climate and topography influence air quality conditions, and provides a detailed description of climate and topography for various subregions in the Bay Area.

Appendix E summarizes the District's activities with respect to toxic air contaminants.

Appendix F summarizes recommended resources and guidance documents that Lead Agencies may wish to consult when developing mitigation measures.

Appendix G provides a glossary.

Appendix H provides the references used in the preparation of this document.

1.3 District Responsibilities

The District is the agency primarily responsible for assuring that national and State ambient air quality standards are attained and maintained in the San Francisco Bay Area. Among the District's many responsibilities are the following: preparation of plans for attaining and maintaining ambient air quality standards in the region; adoption and enforcement of rules and regulations concerning air pollutant sources; issuing permits for stationary sources of air pollutants; inspecting stationary sources of air pollutants and responding to citizen complaints; monitoring ambient air quality and meteorological conditions; awarding grants to reduce motor vehicle emissions; conducting public education campaigns; and many other activities. The District's jurisdiction includes all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo and Santa Clara Counties, and the southern portions of Solano and Sonoma Counties. Figure 1 shows the boundaries of the District's jurisdiction. Further information about District activities is provided in Appendix A.

In its efforts to reduce air pollution and achieve ambient air quality standards, the District also works with many other agencies and organizations, including: U.S. Environmental Protection Agency, California Air Resources Board, Metropolitan Transportation Commission, Association of Bay Area Governments, congestion management agencies, cities and counties, and various non-governmental organizations. Appendix A provides further information regarding other agencies with whom the District cooperates. Appendix A also provides an overview of federal and State laws and programs that affect air quality.

The District is involved in the CEQA process in a variety of ways.

Lead Agency - The District acts as a Lead Agency when it has the primary authority to implement or approve a project. The District acts as a Lead Agency when it adopts air quality plans for the region, as well as when it adopts rules and regulations. The District also occasionally acts as a Lead Agency, or prepares supplemental environmental documentation, for projects subject to District permit requirements.

Responsible Agency - The District acts as a Responsible Agency when it has discretionary authority over a project, but does not have the primary discretionary authority of a Lead Agency. As a Responsible Agency, the District may coordinate the environmental review process with the District's permitting process, provide comments to the Lead Agency regarding potential impacts, and recommend mitigation measures.

Commenting Agency - The District acts as a Commenting Agency when it is not a Lead or Responsible Agency (i.e., it does not have discretionary authority over a project), but when it may have concerns about the air quality impacts of a proposed project or plan. As a Commenting Agency, the District reviews environmental documents prepared for development proposals and plans in the Bay Area and provides comments to Lead Agencies regarding air quality impacts and mitigation measures.

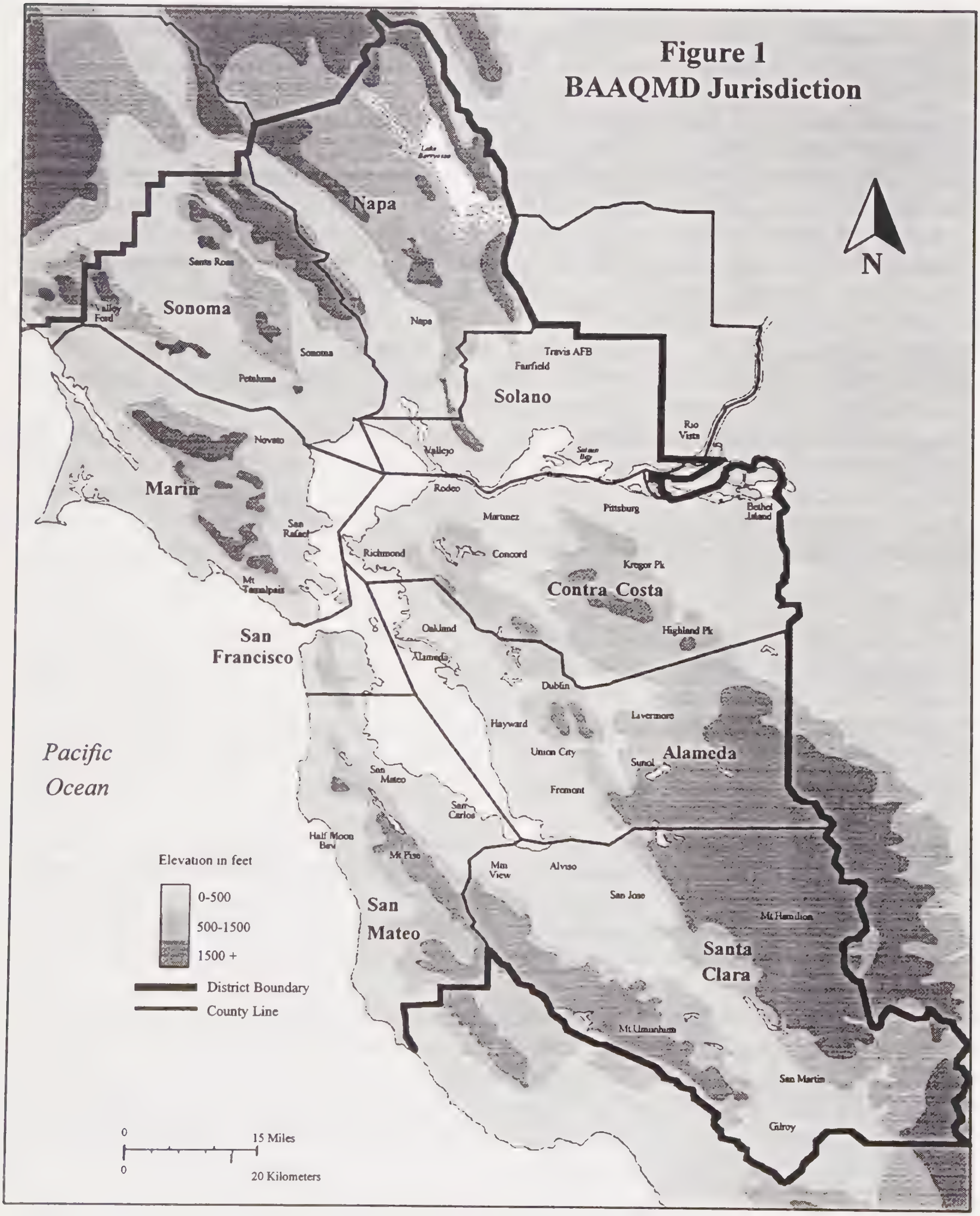
Figure 1
BAAQMD Jurisdiction
N
Napa
Sonoma
Santa Rosa
Valley Ford
Napa
Sonoma
Petaluma
Travis AFB
Fairfield
Solano
Rio Vista
Novato
Vallejo
Marin
Rodeo
Pittsburg
Bethel Island
Martinez
San Rafael
Richmond
Concord
Kregor Pk
Mt Tamalpais
Contra Costa
Oakland
Highland Pk
San Francisco
Alameda
Dublin
Livermore
Hayward
Pacific Ocean
Union City
Sunol
Alameda
San Mateo
Fremont
San Carlos
Half Moon Bay
Mt Pise
Mtn View
Alviso
Elevation in feet
0-500
500-1500
1500 +
San Mateo
San Jose
Mt Hamilton
Santa Clara
District Boundary
County Line
Mt Umunhum
San Martin
Gilroy
0
15 Miles
0
20 Kilometers

1.4 Air Pollutants of Concern in the Bay Area

State and national ambient air quality standards have been established for the following pollutants: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter (PM_{10}) and lead. For some of these pollutants, notably ozone and PM_{10}, the State standards are more stringent than the national standards. The State has also established ambient air quality standards for sulfates, hydrogen sulfide, vinyl chloride and visibility reducing particles. The above-mentioned pollutants are generally known as "criteria pollutants." Appendix A provides further information on ambient air quality standards.

District regulations and programs seek to minimize emissions of all air pollutants. These Guidelines, however, focus primarily on the criteria pollutants for which the region still periodically exceeds State standards (ozone and PM_{10}) or for which the region occasionally exceeded State or national standards in the recent past (carbon monoxide).

Ground level ozone, often referred to as smog, is not emitted directly, but is formed in the atmosphere through complex chemical reactions between nitrogen oxides (NO_x) and reactive organic gases (ROG) in the presence of sunlight. The principal sources of NO_x and ROG, often termed ozone precursors, are combustion processes (including motor vehicle engines) and evaporation of solvents, paints and fuels. Motor vehicles are the single largest source of ozone precursor emissions in the Bay Area. Exposure to ozone can cause eye irritation, aggravate respiratory diseases and damage lung tissue, as well as damage vegetation and reduce visibility.

Fine particulate matter (PM_{10}, or particulate matter less than 10 microns in diameter) includes a wide range of solid or liquid particles, including smoke, dust, aerosols and metallic oxides. There are many sources of PM_{10} emissions, including combustion, industrial processes, grading and construction, and motor vehicles. Of the PM_{10} emissions associated with motor vehicle use, some are tailpipe and tire wear emissions, but greater quantities are generated by resuspended road dust. Consequently, improvements in motor vehicle engines and fuels have not reduced PM_{10} emissions as significantly as they have reduced emissions of other pollutants. Reductions in motor vehicle *use* are needed to significantly reduce PM_{10} emissions from resuspended road dust. District research also has shown that wood burning in fireplaces and stoves is a significant source of PM_{10}, particularly during episodes when PM_{10} levels are at their highest.

Fine particulate matter is of concern because it can bypass the body's natural filtration system more easily than larger particles, and can lodge deep in the lungs. Health effects of PM_{10} vary depending on a variety of factors, including the type and size of particle. Research has demonstrated a correlation between high PM_{10} concentrations and increased mortality rates. Elevated PM_{10} concentrations can also aggravate chronic respiratory illness such as bronchitis and asthma.

Carbon monoxide (CO) is an odorless, colorless gas that is formed by the incomplete combustion of fuels. Motor vehicles are by far the single largest source of CO in the Bay Area. At high concentrations, CO reduces the oxygen-carrying capacity of the blood and can cause headaches, dizziness, unconsciousness, and even death. CO also can aggravate cardiovascular disease.

In addition to the criteria pollutants discussed above, toxic air contaminants (TACs) are another group of pollutants of concern in the Bay Area. There are many different types of TACs, with varying degrees of toxicity. Sources of TACs include industrial processes such as petroleum refining and chrome plating operations, commercial operations such as gasoline stations and dry cleaners, and motor vehicle exhaust. Public exposure to TACs can result from emissions from normal operations, as well as accidental releases of hazardous materials during upset conditions. Health effects of TACs include cancer, birth defects, neurological damage and death.

Other air quality issues of concern in the Bay Area include nuisance impacts of odors and dust. Objectionable odors may be associated with a variety of pollutants. Common sources of odors include wastewater treatment plants, landfills, composting facilities, refineries and chemical plants. Similarly, nuisance dust may be generated by a variety of sources including quarries, agriculture, grading and construction. Odors rarely have direct health impacts, but they can be very unpleasant and can lead to anger and concern over possible health effects among the public. Each year the District receives thousands of citizen complaints about objectionable odors. Dust emissions can contribute to increased ambient concentrations of PM_{10}, particularly when dust settles on roadways where it can be pulverized and resuspended by traffic. Dust emissions also contribute to reduced visibility and soiling of exposed surfaces.

1.5 Air Quality Conditions in the Bay Area

Air quality conditions in the San Francisco Bay Area have improved significantly since the District was created in 1955. Ambient concentrations of air pollutants and the number of days on which the region exceeds air quality standards have fallen dramatically. With the region's June 1995 redesignation as an attainment area for the national ozone standard, the Bay Area is now the largest metropolitan region in the United States to have achieved that distinction. Public health benefits, improved visibility, and reduced damage to plants and materials are among the benefits of this progress.

Continued progress is necessary, however. Unusual heat waves triggered new exceedances of the national ozone standard during the summer of 1995. The region also periodically exceeds State ambient air quality standards for ozone and particulate matter. The State standards for these pollutants are more stringent than the national standards. Exceedances of air quality standards occur primarily during meteorological conditions conducive to high pollution levels, such as cold, windless winter nights or hot, sunny summer afternoons. As is true throughout much of the U.S., motor vehicle use is projected to increase substantially in the region. The District, local jurisdictions, and other parties responsible for protecting public health and welfare will need to continue to minimize the air quality impacts of growth and development.

Table 1 provides a summary of the current attainment status for the San Francisco Bay Area with respect to national and State ambient air quality standards. Appendix B provides information regarding sources and effects of air pollutants. Appendix C discusses air pollutant status, problems and trends in the Bay Area.

TABLE 1
BAY AREA ATTAINMENT STATUS AS OF APRIL 1996

Pollutant	Averaging Time	California Standards [1]		National Standards [2]	
		Concentration	**Attainment Status**	**Concentration**	**Attainment Status**
Ozone	1 Hour	0.09 ppm (180 $\mu g/m^3$)	N	0.12 ppm (235 $\mu g/m^3$)	A[3]
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m^3)	A	9 ppm (10 mg/m^3)	Urban[4] areas N[5] Rural areas A
	1 Hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	A
Nitrogen Dioxide	Annual Average			0.053 ppm (100 $\mu g/m^3$)	A
	1 Hour	0.25 ppm (470 $\mu g/m^3$)	A		
Sulfur Dioxide	Annual Average			80 $\mu g/m^3$ (0.03 ppm)	A
	24 Hour	0.04 ppm (105 $\mu g/m^3$)	A	365 $\mu g/m^3$ (0.14 ppm)	A
	1 Hour	0.25 ppm (655 $\mu g/m^3$)	A		
Suspended Particulate Matter (PM_{10})	Annual Arithmetic Mean			50 $\mu g/m^3$	A
	Annual Geometric Mean	30 $\mu g/m^3$	N		
	24 Hour	50 $\mu g/m^3$	N	150 $\mu g/m^3$	U

A=Attainment N=Nonattainment U=Unclassified
ppm=parts per million mg/m^3=milligrams per cubic meter. $\mu g/m^3$=micrograms per cubic meter.

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and PM_{10} are values that are not to be exceeded. If the standard is for a 1-hour, 8-hour or 24-hour average, then some measurements may be excluded. In particular, measurements are excluded that ARB determines would occur less than once per year on the average.
2. National standards other than for ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. For example, the ozone standard is attained if, during the most recent three-year period, the average number of days per year with maximum hourly concentrations above the standard is equal to or less than one .
3. In June 1995 the Bay Area was redesignated to attainment for the national ozone standard.
4. Urbanized areas as defined by U.S. Department of Commerce, Bureau of Census, 1980 Census of Population and Housing, Block Statistics Maps for San Jose and Vallejo-Fairfield-Napa SMSAs.
5. The BAAQMD has applied for attainment status for carbon monoxide. No BAAQMD monitoring station has recorded an exceedance of the national CO standard since 1991.

- Provide neighborhood retail within or adjacent to large residential developments.
- Provide services, such as restaurants, banks, copy shops, post office, etc., within office parks and other large employment centers.
- Encourage infill development.
- Ensure that the design of streets, sidewalks and bike paths/routes within a development encourages walking and biking.
- Orient building entrances towards sidewalks and transit stops.
- Provide landscaping to reduce energy demand for cooling.
- Orient buildings to minimize energy required for heating and cooling.

Local governments and other Lead Agencies are encouraged to consider land use and design measures to reduce auto use and promote energy conservation early in planning and development review processes. By incorporating such measures in local plans and addressing them during initial contacts with project proponents, Lead Agencies greatly increase the likelihood of their implementation. The environmental impacts of development proposals may be lessened and environmental review processes simplified.

Further information regarding land use and design strategies is provided in Chapter 4 and Appendix F. Also, the District and ABAG have prepared a guidance document on these issues entitled *Improving Air Quality Through Local Plans and Programs*. The document provides guidance to local officials and staff on developing and implementing local policies and programs to improve air quality. Lead Agency staff also may contact District planners for assistance.

Land Use Conflicts and Sensitive Receptors - The location of a development project is a major factor in determining whether it will result in localized air quality impacts. The potential for adverse air quality impacts increases as the distance between the source of emissions and members of the public decreases. Impacts on sensitive receptors are of particular concern. Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors.

For each of the situations discussed below, the impacts generally are not limited only to sensitive receptors. *All* members of the population can be adversely affected by criteria pollutants, toxic air contaminants, odor and dust, and thus any consideration of potential air quality impacts should include all members of the population. This discussion focuses on sensitive receptors, however, because they are the people most vulnerable to the effects of air pollution.

Air quality problems arise when sources of air pollutants and sensitive receptors are located near one another. There are several types of land use conflicts that should be avoided:

- A sensitive receptor is in close proximity to a congested intersection or roadway with high levels of emissions from motor vehicles. High concentrations of carbon monoxide, fine particulate matter or toxic air contaminants are the most common concerns.

- A sensitive receptor is close to a source of toxic air contaminants or a potential source of accidental releases of hazardous materials.

- A sensitive receptor is close to a source of odorous emissions. Although odors generally do not pose a health risk, they can be quite unpleasant and often lead to citizen complaints to the District and to local governments.

- A sensitive receptor is close to a source of high levels of nuisance dust emissions.

Localized impacts to sensitive receptors generally occur in one of two ways:

- A (new) source of air pollutants is proposed to be located close to existing sensitive receptors. For example, an industrial facility is proposed for a site near a school.

- A (new) sensitive receptor is proposed near an existing source of air pollutants. For example, a residential development is proposed near a wastewater treatment plant.

Early consultation between project proponents and Lead Agency staff can avoid or minimize localized impacts to sensitive receptors. When evaluating whether a development proposal has the potential to result in localized impacts, Lead Agency staff need to consider the nature of the air pollutant emissions, the proximity between the emitting facility and sensitive receptors, the direction of prevailing winds, and local topography. Often, the provision of an adequate distance, or buffer zone, between the source of emissions and the receptor(s) is necessary to mitigate the problem. This underscores the importance of addressing these potential land use conflicts during the preparation of the general plan and as early as possible in the development review process for specific projects.

It should be noted that there may be instances when some of the land use considerations discussed above, such as infill development and mixed use projects, could result in localized impacts to sensitive receptors. For example, an infill or mixed use project might result in residences being in close proximity to a source of odors or toxic air contaminants. Or a child care facility might be proposed at a worksite in an area where large quantities of hazardous materials are stored and used. Such situations should be avoided. Lead Agencies should bear in mind that while infill and mixed use development are desirable (to reduce auto trips), such projects should be approved only when they do not subject receptors to health or nuisance impacts.

BAAQMD Rules and Regulations - District regulations and permit requirements apply to most industrial processes (e.g., manufacturing facilities, cement terminals, food processing), many commercial operations (e.g., print shops, drycleaners, gasoline stations), and other miscellaneous activities (e.g., demolition of buildings containing asbestos and aeration of contaminated soils). During early consultation, Lead Agency staff should address air pollution regulations and requirements of other public agencies that may apply to the proposed project. Lead Agency staff are encouraged to coordinate directly with the District during the environmental review process on issues such as regulatory requirements, impact analyses and mitigation measures.

2.2 Preparation of the Initial Study

Projects that are subject to CEQA generally undergo a preliminary evaluation in an Initial Study, which is prepared by the Lead Agency. The Initial Study is used to determine if a project may have a significant effect on the environment. The Initial Study should evaluate the potential impact of a proposed project upon air quality. The air quality impact of a project is determined by examining the types and levels of emissions generated by the project, the existing air quality conditions and neighboring land uses. The Initial Study should analyze all phases of project planning, construction and operation, as well as cumulative impacts. The District recommends that the answers/determinations provided in an Initial Study checklist be explained.[1]

The District has established significance thresholds to assist Lead Agencies in determining whether a project or plan may have a significant air quality impact. The District's thresholds of significance are based on the State Office of Planning and Research definitions of significant environmental effect. Section 15382 of the State CEQA Guidelines defines "significant effect on the environment" as "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including ... air."

Appendix G to the State CEQA Guidelines contains a list of effects that will normally be considered significant. These include:

- A project that will "violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations,"
- A project that "conflicts with adopted environmental plans or goals of the community where it is located,"
- A project that would "create a potential public health hazard or involve the use, production or disposal of materials which pose a hazard to people or animal or plant populations in the area affected," or
- A project that would "have a substantial, demonstrable negative aesthetic effect."

Appendix I of the State CEQA Guidelines also indicates that a project could have a significant air quality impact if it would result in:

- "The creation of objectionable odors," or
- "Alteration of air movement, moisture, or temperature, or change in climate, either locally or regionally."

The Lead Agency should determine whether the proposed project or plan would exceed any of the thresholds discussed in this chapter. If any of the thresholds are exceeded, then an EIR should be prepared. The more comprehensive analysis of an EIR will provide a more detailed picture of the project's or plan's impacts and will help identify the most appropriate and effective

[1] The Initial Study identifies potential effects by use of a checklist, matrix or other method. The process, contents, and use of the Inital Study are contained in Section 15063 and Appendix I of the State CEQA Guidelines.

mitigation measures to minimize the impacts. Where no significant air quality impacts of a project or plan can be identified in the Initial Study (i.e., none of the significance thresholds are exceeded), the District recommends the Lead Agency either prepare a Negative Declaration or include in an EIR a statement indicating the reasons why potential air quality impacts were determined not to be significant.

Sources of air pollutant emissions complying with all applicable District regulations generally will not be considered to have a significant air quality impact.[2] Stationary sources that are exempt from District permit requirements because they fall below emission thresholds for permitting will not be considered to have a significant air quality impact (unless it is demonstrated that they may have a significant cumulative impact). The Lead Agency can and should make exception to this determination if special circumstances suggest that the emissions from the permitted or exempt source may cause a significant air quality impact. For example, if a permitted or exempt source may emit objectionable odors, then odor impacts on nearby receptors should be considered a potentially significant air quality impact.

2.3 Thresholds of Significance

This section describes the District's recommended thresholds of significance to be used by a Lead Agency when preparing an Initial Study. If, during the preparation of the Initial Study, the Lead Agency finds that any of the following thresholds may be exceeded, then an EIR should be prepared in order to more accurately evaluate project impacts and identify mitigation measures. These thresholds also may be used when preparing an EIR. If the more detailed analysis in an EIR indicates that any of these thresholds would be exceeded, the document should identify the impact as a significant air quality impact and propose mitigation measures. Chapter 3 explains how to calculate emissions to determine whether the thresholds have been exceeded. The following thresholds address impacts associated with: 1) project construction, 2) project operations, and 3) plans.

Threshold of Significance for Construction Impacts

Construction-related emissions are generally short-term in duration, but may still cause adverse air quality impacts. Fine particulate matter (PM_{10}) is the pollutant of greatest concern with respect to construction activities.[3] PM_{10} emissions can result from a variety of construction activities, including excavation, grading, demolition, vehicle travel on paved and unpaved surfaces, and vehicle and equipment exhaust. Construction-related emissions can cause substantial increases in localized concentrations of PM_{10}. Particulate emissions from construction activities can lead to adverse health effects as well as nuisance concerns such as reduced visibility and soiling of exposed surfaces.

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[2] CEQA Guidelines, Section 15064(i).

[3] Construction equipment emits carbon monoxide and ozone precursors. However, these emissions are included in the emission inventory that is the basis for regional air quality plans, and are not expected to impede attainment or maintenance of ozone and carbon monoxide standards in the Bay Area.

Construction emissions of PM_{10} can vary greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, weather conditions and other factors. Despite this variability in emissions, experience has shown that there are a number of feasible control measures that can be reasonably implemented to significantly reduce PM_{10} emissions from construction. The District's approach to CEQA analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

The District has identified a set of feasible PM_{10} control measures for construction activities. These control measures are listed in Table 2. As noted in the table, some measures ("Basic Measures") should be implemented at all construction sites, regardless of size. Additional measures ("Enhanced Measures") should be implemented at larger construction sites (greater than 4 acres) where PM_{10} emissions generally will be higher. Table 2 also lists other PM_{10} controls ("Optional Measures") that may be implemented if further emission reductions are deemed necessary by the Lead Agency.

The determination of significance with respect to construction emissions should be based on a consideration of the control measures to be implemented. From the District's perspective, quantification of construction emissions is not necessary (although a Lead Agency may elect to do so - see Section 3.3 of these Guidelines, "Calculating Construction Emissions," for guidance). The Lead Agency should review Table 2. If all of the control measures indicated in Table 2 (as appropriate, depending on the size of the project area) will be implemented, then air pollutant emissions from construction activities would be considered a less than significant impact. If all of the appropriate measures in Table 2 will not be implemented, then construction impacts would be considered to be significant (unless the Lead Agency provides a detailed explanation as to why a specific measure is unnecessary or not feasible).

Project construction sometimes requires the demolition of existing buildings at the project site. Buildings constructed prior to 1980 often include building materials containing asbestos. Airborne asbestos fibers pose a serious health threat. The demolition, renovation or removal of asbestos-containing building materials is subject to the limitations of District Regulation 11, Rule 2: Hazardous Materials; Asbestos Demolition, Renovation and Manufacturing. The District's Enforcement Division should be consulted prior to commencing demolition of a building containing asbestos building materials. Any demolition activity subject to but not complying with the requirements of District Regulation 11, Rule 2 would be considered to have a significant impact.

TABLE 2
FEASIBLE CONTROL MEASURES FOR CONSTRUCTION EMISSIONS OF PM_{10}

Basic Control Measures. - The following controls should be implemented at all construction sites.

- Water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials *or* require all trucks to maintain at least two feet of freeboard.
- Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas and staging areas at construction sites.
- Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.

Enhanced Control Measures. - The following measures should be implemented at construction sites greater than four acres in area.

- All "Basic" control measures listed above.
- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded areas inactive for ten days or more).
- Enclose, cover, water twice daily or apply (non-toxic) soil binders to exposed stockpiles (dirt, sand, etc.)
- Limit traffic speeds on unpaved roads to 15 mph.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Replant vegetation in disturbed areas as quickly as possible.

Optional Control Measures. - The following control measures are strongly encouraged at construction sites that are large in area, located near sensitive receptors or which for any other reason may warrant additional emissions reductions.

- Install wheel washers for all exiting trucks, or wash off the tires or tracks of all trucks and equipment leaving the site.
- Install wind breaks, or plant trees/vegetative wind breaks at windward side(s) of construction areas.
- Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 mph.
- Limit the area subject to excavation, grading and other construction activity at any one time.

Thresholds of Significance for Impacts From Project Operations

For many types of land use development, such as office parks, shopping centers, residential subdivisions and other "indirect sources", motor vehicles traveling to and from the projects represent the primary source of air pollutant emissions associated with project operations. Significance thresholds discussed below address the impacts of these indirect source emissions on local and regional air quality. Thresholds are also provided for other potential impacts related to project operations, such as odors and toxic air contaminants.

(Lead Agencies may refer to Section 2.4, Project Screening, for guidance on determining whether significance thresholds for project operations may be exceeded, and thus whether more detailed air quality analysis may be needed.)

1. **Local Carbon Monoxide Concentrations.** Localized carbon monoxide concentrations should be estimated for projects in which: 1) vehicle emissions of CO would exceed 550 lb./day, 2) project traffic would impact intersections or roadway links operating at Level of Service (LOS) D, E or F or would cause LOS to decline to D, E or F, or 3) project traffic would increase traffic volumes on nearby roadways by 10% or more.[4] A project contributing to CO concentrations exceeding the State Ambient Air Quality Standard of 9 parts per million (ppm) averaged over 8 hours and 20 ppm for 1 hour would be considered to have a significant impact.

2. **Total Emissions.** Total emissions from project operations should be compared to the thresholds provided in Table 3.[5] Total operational emissions evaluated under this threshold should include all emissions from motor vehicle use associated with the project. A project that generates criteria air pollutant emissions in excess of the annual *or* daily thresholds in Table 3 would be considered to have a significant air quality impact.

TABLE 3
THRESHOLDS OF SIGNIFICANCE
FOR PROJECT OPERATIONS

Pollutant	ton/yr	lb/day	kgm/day
ROG	15	80	36
NO_X	15	80	36
PM_{10}	15	80	36

3. **Odors.** While offensive odors rarely cause any physical harm, they still can be very unpleasant, leading to considerable distress among the public and often generating citizen complaints to local governments and the District. Any project with the potential to frequently

[4] Unless the increase in traffic volume is less than 100 vehicles per hour.

[5] The thresholds for ROG and NOx are equivalent to the District offset requirement threshold (15 tons per year) for stationary sources (Regulation 2-2-302). The threshold for PM_{10} is based on the District's definition of a major modification to a major facility (Regulation 2-2-221).

expose members of the public to objectionable odors would be deemed to have a significant impact. Odor impacts on residential areas and other sensitive receptors warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, worksites and commercial areas. Analysis of potential odor impacts should be conducted for both of the following situations: 1) sources of odorous emissions locating near existing receptors, *and* 2) receptors locating near existing odor sources.[6]

Determining the significance of potential odor impacts involves a two-step process. *First*, determine whether the project would result in an odor source and receptors being located within the distances indicated in Table 4. Table 4 lists types of facilities known to emit objectionable odors. The Lead Agency should evaluate facilities not included in Table 4 or projects separated by greater distances than indicated in Table 4 if warranted by local conditions or special circumstances. *Second*, if the proposed project would result in an odor source and receptors being located closer than the screening level distances indicated in Table 4, a more detailed analysis, as described in Chapter 3, should be conducted.

After reviewing District enforcement records as described in Chapter 3, a determination of significance should be made. For a project locating near an existing source of odors, the project should be identified as having a significant odor impact if it is proposed for a site that is closer to an existing odor source than any location where there has been:

a) more than one confirmed complaint per year averaged over a three year period, or
b) three unconfirmed complaints per year averaged over a three year period.

For projects locating near a source of odors where there is currently no nearby development *and* for odor sources locating near existing receptors, the determination of significance should be based on the distance and frequency at which odor complaints from the public have occurred in the vicinity of a similar facility.

If a proposed project is determined to result in potential odor problems, mitigation measures should be identified. For some projects, add-on controls or process changes, such as carbon absorption, incineration or relocation of stacks/vents, can reduce odorous emissions. In many cases, however, the most effective mitigation strategy is the provision of a sufficient distance, or buffer zone, between the source and the receptor(s).

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6 In a January, 1995 decision (*Baird v. County of Contra Costa*, 32 Cal. App. 4th 1464), a California appellate court held that the effects of a contaminated pre-existing environment upon the residents of a proposed project were beyond the scope of CEQA.

Notwithstanding this decision, the District believes that the Legislature generally did intend that CEQA documents should consider the effects of the pre-existing environment on a proposed project, and that the ruling in the *Baird* case should be limited to the factual particulars of the decision (which involved a neighborhood group's attempt to set aside the approval of an addiction treatment facility).

In the District's view, Lead Agencies therefore should not rely on the *Baird* decision and should analyze the impacts of existing sources of air pollution on occupants or residents of proposed projects. Such impacts include, but are not limited to, those from toxic air contaminants, odors and dust.

TABLE 4
PROJECT SCREENING TRIGGER LEVELS
FOR POTENTIAL ODOR SOURCES

Type of Operation	Project Screening Distance
Wastewater Treatment Plant	1 mile
Sanitary Landfill	1 mile
Transfer Station	1 mile
Composting Facility	1 mile
Petroleum Refinery	2 miles
Asphalt Batch Plant	1 mile
Chemical Manufacturing	1 mile
Fiberglass Manufacturing	1 mile
Painting/Coating Operations (e.g. auto body shops)	1 mile
Rendering Plant	1 mile
Coffee Roaster	1 mile

4. **Toxic Air Contaminants.** Any project with the potential to expose sensitive receptors (including residential areas) or the general public to substantial levels of toxic air contaminants would be deemed to have a significant impact. This applies to receptors locating near existing sources of toxic air contaminants, as well as sources of toxic air contaminants locating near existing receptors.

Proposed development projects that have the potential to expose the public to toxic air contaminants in excess of the following thresholds would be considered to have a significant air quality impact. These thresholds are based on the District's Risk Management Policy.

<u>Thresholds of Significance for Toxic Air Contaminants</u>

1. Probability of contracting cancer for the Maximally Exposed Individual (MEI) exceeds 10 in one million.
2. Ground-level concentrations of non-carcinogenic toxic air contaminants would result in a Hazard Index greater than 1 for the MEI.

5. **Accidental Releases/Acutely Hazardous Air Emissions.** The determination of significance for potential impacts from accidental releases of acutely hazardous materials should be made in consultation with the local administering agency of the Risk Management Prevention Program (RMPP). The county health department is usually the administering agency. A determination of significance regarding accidental releases of acutely hazardous materials (AHMs) should be made for: 1) projects using or storing AHMs locating near existing receptors, and 2) development projects resulting in receptors locating near existing facilities using or storing AHMs.

The District recommends, at a minimum, that the Lead Agency, in consultation with the administering agency of the RMPP, find that any project resulting in receptors being within the Emergency Response Planning Guidelines (ERPG) exposure level 2 for a facility has a significant air quality impact. ERPG exposure level 2 is defined as "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action".[7]

6. Cumulative Impacts. Any proposed project that would individually have a significant air quality impact (see Thresholds of Significance for Impacts from Project Operations, above) would also be considered to have a significant cumulative air quality impact.

For any project that does not individually have significant operational air quality impacts, the determination of significant cumulative impact should be based on an evaluation of the consistency of the project with the local general plan *and* of the general plan with the regional air quality plan. (The appropriate regional air quality plan for the Bay Area is the most recently adopted Clean Air Plan.) See Thresholds of Significance for Plan Impacts, below, for guidance on evaluating the consistency of a local general plan with the Clean Air Plan. Figure 2 provides a flow chart depicting the process for evaluating cumulative impacts.

Projects in Jurisdictions with Local Plans Consistent with the Clean Air Plan

If a project is proposed in a city or county with a general plan that is consistent with the Clean Air Plan (see below) *and* the project is consistent with that general plan (i.e., it does not require a general plan amendment), then the project will not have a significant cumulative impact (provided, of course, the project does not individually have any significant impacts). No further analysis regarding cumulative impacts is necessary.

In a jurisdiction with a general plan consistent with the Clean Air Plan, a project may be proposed that is not consistent with that general plan because it requires a general plan amendment (GPA). In such instances, the cumulative impact analysis should consider the difference(s) between the project and the original (pre-GPA) land use designation for the site with respect to motor vehicle use and potential land use conflicts. A project would not have a significant cumulative impact if: VMT from the project would not be greater than the VMT that would be anticipated under the original land use designation, and 2) the project would not result in sensitive receptors being in close proximity to sources of objectionable odors, toxics or accidental releases of hazardous materials.

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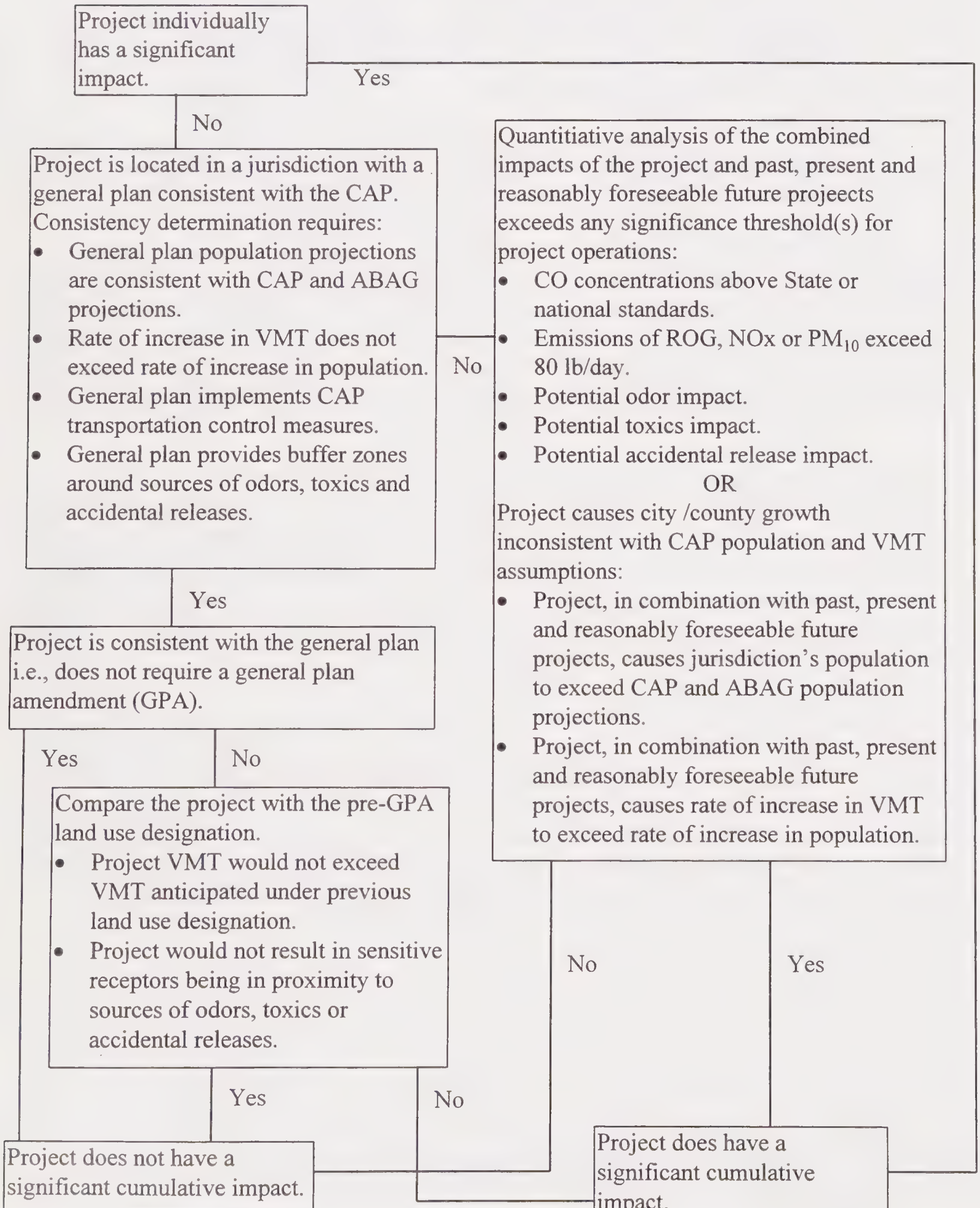
[7] State of California Guidance for the Preparation of a Risk Management and Prevention Program, California Office of Emergency Services, November 1989, pg. D-2.

FIGURE 2

EVALUATING CUMULATIVE IMPACTS



Lead Agencies should note that demonstrating general plan consistency with the CAP (and project consistency with the general plan) is the minimum that must be done to support a finding of no significant cumulative impact. Depending on the specific type of project and its setting, there may be additional measures - such as additional measures to reduce auto use, scrappage of high emitting vehicles, conversion to alternative fuels, etc. - that could be implemented to reduce emissions. Even in jurisdictions with a general plan consistent with the CAP, Lead Agencies are encouraged to pursue all feasible measures to minimize cumulative air quality impacts.

Projects in Jurisdictions with Local Plans Not Consistent with the Clean Air Plan

For a project in a city or county with a general plan that is not consistent with the Clean Air Plan, the cumulative impact analysis should consider the combined impacts of the proposed project and past, present and reasonably anticipated future projects. ("Reasonably anticipated future projects" should include, at a minimum, projects of which the Lead Agency is aware based on applications for permits and other land use entitlements, environmental documents, and discussions with probable future developers.) A project would have a significant cumulative impact if these combined impacts would exceed any of the thresholds established above for project operations. A quantitative analysis of past, present and future projects would be required as part of this determination. The analysis should also address how the project and past, present and future projects would influence population and vehicle use projections (see Thresholds of Significance for Plan Impacts, Determining Consistency with Clean Air Plan Population and VMT Assumptions, below).

Thresholds of Significance for Plan Impacts

Regarding plans, the State CEQA Guidelines, Section 15125(b), states that an EIR shall discuss "any inconsistencies between a proposed project and applicable general plans and regional plans. Such regional plans include, but are not limited to, the applicable Air Quality Management Plan (or State Implementation Plan)...". General Plans of cities and counties must show consistency with regional plans and policies affecting air quality to claim a less than significant impact on air quality. General plan amendments, redevelopment plans, specific area plans, annexations of lands and services, and similar planning activities should receive the same scrutiny as general plans with respect to consistency with regional air quality plans.

For a local plan to be consistent with the regional air quality plan it must be consistent with the most recently adopted Clean Air Plan (CAP). (At the time of this writing, April 1996, the most recently adopted CAP is the *Bay Area '94 Clean Air Plan.*) The goal of the CAP is to reduce ground-level ozone and satisfy other California Clean Air Act (CCAA) requirements (e.g., performance objectives related to motor vehicle use). *All of the following criteria must be satisfied for a local plan to be determined to be consistent with the CAP.* Local plans found to be consistent with the CAP would have a less than significant impact on air quality.

1. Determining Local Plan Consistency With Clean Air Plan Population and VMT Assumptions. Plans must show over the planning period of the plan that:

a) population growth for the jurisdiction will not exceed the values included in the current CAP[8], and
b) the rate of increase in VMT for the jurisdiction is equal to or lower than the rate of increase in population.

The first criterion (a) is necessary to establish that population growth in cities and counties will not exceed the growth assumed in the preparation of the CAP emission inventory. Air pollutant emissions are a function of population and human activity. If growth in population is greater than assumed in the CAP emission inventory, then population-based emissions also are likely to be greater than assumed in the CAP. Consequently, attainment of the State air quality standards would be delayed. Therefore, plans showing estimated population greater than that assumed in the *ABAG Projections* would be inconsistent with air quality planning and have a significant air quality impact.

The second plan criterion (b) is derived from the CCAA, Section 40919(d), which requires regions to implement "transportation control measures to substantially reduce the rate of increase in passenger vehicle trips and miles traveled." Plans showing a VMT growth rate higher than the population growth rate would be considered to be hindering progress towards achieving this performance objective, and thus inconsistent with regional air quality planning. This would represent a significant air quality impact.[9]

2. Determining Local Plan Consistency With Clean Air Plan Transportation Control Measures. Determining consistency of local plans with the CAP also involves assessing whether CAP transportation control measures (TCMs) for which local governments are implementing agencies are indeed being implemented. The CAP identifies implementing agencies/entities for each of the TCMs included in the Plan. Cities and counties are identified among the implementing agencies for some of the TCMs. These TCMs are listed in Table 5. Local plans that do not demonstrate reasonable efforts to implement TCMs in the CAP would be considered to be inconsistent with the regional air quality plan and therefore have a significant air quality impact. For further information regarding CAP TCMs, refer to Appendix A of these Guidelines and the *Bay Area '94 Clean Air Plan.*

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[8] For the *1994 CAP*, ABAG's *Projections '94* are the appropriate set of population projections.

[9] In some cases, estimating total VMT at the general plan horizon year may be beyond the level of analysis historically conducted in assessing general plan impacts. Lead Agencies may wish to consult with MTC and the county congestion management agency for assistance in developing VMT estimates.

TABLE 5
CAP TCMs TO BE IMPLEMENTED BY LOCAL GOVERNMENT

Transportation Control Measure	Description
1. Expand Employer Assistance Program	• Provide assistance to regional and local ridesharing organizations.
9. Improve Bicycle Access and Facilities	• Establish and maintain bicycle advisory committees in all nine Bay Area counties. • Develop comprehensive bicycle plans. • Encourage employers and developers to provide bicycle access and facilities. • Improve and expand bicycle lane system.
12. Improve Arterial Traffic Management	• Continue ongoing local signal timing programs. • Study signal preemption for buses on arterials with high volume of bus traffic. • Expand signal timing programs. • Improve arterials for bus operations and to encourage bicycling.
13. Transit Use Incentives	• Expand marketing and distribution of transit passes and tickets. • Set up local transportation stores to sell passes, distribute information.
15. Local Clean Air Plans, Policies and Programs	• Incorporate air quality beneficial policies and programs into local planning and development activities, with a particular focus on subdivision, zoning and site design measures that reduce the number and length of single-occupant automobile trips.

3. **Local Plan Impacts Associated with Odors and Toxics.** For local plans to have a less than significant impact with respect to potential odors and/or toxic air contaminants, buffer zones should be established around existing and proposed land uses that would emit these air pollutants. Buffer zones to avoid odors and toxics impacts should be reflected in local plan policies, land use map(s), and implementing ordinances (e.g., zoning ordinance). Refer to the discussion regarding project operations impacts related to odors, toxics and accidental releases for guidance in establishing buffer zones in local plans.

2.4 Project Screening

It sometimes may be evident to the Lead Agency that an EIR will be required for a project. In such cases the Lead Agency may forgo preparing an Initial Study and immediately begin preparing an EIR (State CEQA Guidelines, Section 15060(c)). In many cases, however, the Lead Agency will need to prepare an Initial Study to determine whether any of the thresholds of

significance discussed in this chapter would be exceeded. Chapter 3 provides guidance on how to assess the air quality impacts of a proposed project.

For one of the thresholds of significance (total emissions from project operations), project screening may provide a simple indication of whether a project may exceed the threshold. The Lead Agency may consult Table 6 for an indication as to whether the threshold for total emissions from project operations might be exceeded. Table 6 provides size or activity levels for various types of land uses which, based on default assumptions, would result in mobile source emissions exceeding the District's threshold of significance for ROG (80 lbs/day). The values provided in Table 6 are based on average, default assumptions for modeling inputs.[10] Therefore, the values in Table 6 represent approximate sizes of projects for which total emissions may exceed the threshold. The values should be used only for project screening, and should not be considered absolute thresholds of project significance. Projects approaching or exceeding the levels indicated in Table 6 should undergo a more detailed analysis, as described in Chapter 3. The District recommends that a more detailed analysis be conducted for any project whose size is within 20% of the values indicated in Table 6. The District generally does not recommend a detailed air quality analysis for projects generating less than 2,000 vehicle trips per day, unless warranted by the specific nature of the project or project setting.

The Lead Agency should note that Table 6 only addresses one threshold of significance. There are other air quality issues, such as high CO concentrations, odors, toxics and cumulative impacts, that must be considered when evaluating a project's potential for causing adverse air quality impacts. Depending on the nature of the project and local conditions, a project below the values in Table 6 could still cause an adverse air quality impact.

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[10] The values were calculated based on the following assumptions:

- Emission factors based on EMFAC7F, Version 1.1.
- Average speed of 30 mph and average trip length of 7.2 miles.
- Analysis year of 1995.
- Trip generation rates as indicated in table.

The total number of trips for projects with potentially significant impacts varies somewhat between land uses. This is primarility because different land uses generate different distributions of trip type (e.g., home to work, home to shop, etc.) with varying percentages of cold and hot starts.

TABLE 6
PROJECTS WITH POTENTIALLY SIGNIFICANT EMISSIONS

Land Use Category	Trip Generation Rate	Size of Project Likely to Generate 80 lb/day ROG
Housing		
Single Family	9.6/D.U.	375 units
Apartments	6.5/D.U.	530 units
Retail		
Discount Store	72.7/1000 sq.ft.	60,000 sq.ft.
Shopping Cntr - Regional	36.3/1000 sq.ft.*	125,000 sq.ft.
Shopping Cntr - Community	54.6/1000 sq.ft.*	80,000 sq.ft.
Shopping Cntr - Neighborhood	118.4/1000 sq.ft.*	38,000 sq.ft.
Supermarket	177.6/1000 sq.ft.	25,000 sq.ft.
Office		
General Office	14/1000 sq.ft.*	305,000 sq.ft.
Government Office	25/1000 sq.ft.*	175,000 sq.ft.
Business Park	14.4/1000 sq.ft.	290,000 sq.ft.
Medical Office	34.2/1000 sq.ft.	130,000 sq.ft.
Industrial		
Light Industry	7.0/1000 sq.ft.	590,000 sq.ft.
Warehouse	4.9/1000 sq.ft.	820,000 sq.ft.
Institutional		
Hospital	16.8/1000 sq.ft.	255,000 sq.ft.
Community College	12.9/1000 sq.ft.	345,000 sq.ft.

* Generalized estimate. Trip rate will vary depending upon size of project. See latest edition of Trip Generation, Institute of Transportation Engineers.

CHAPTER 3 - ASSESSING AIR QUALITY IMPACTS

3.1 Introduction

This chapter provides guidance on how to evaluate the impact(s) of a proposed project or plan[11] on local and regional air quality. The impact assessment portion of an environmental document should evaluate all stages of a project. This chapter addresses the following issues:

- Information that should be discussed in the description of the project's environmental setting
- Evaluating emissions from project construction
- Calculating emissions from project operations, including:
  - mobile source (or "indirect") emissions
  - localized carbon monoxide concentrations
  - stationary source emissions
  - odor impacts
  - toxic air contaminants
- Cumulative impacts

The basic method for calculating project emissions is to apply specific emission factors to sources of air pollutants whose magnitude and characteristics are either known or estimated. Emission factors may be defined as standardized relationships between particular sources of air pollution, such as motor vehicles or pieces of industrial equipment, and their air pollutant emissions. For example, emission factors for motor vehicles generally specify the amount (in grams) of certain air pollutants emitted, per mile traveled. This chapter provides emission factors and quantification procedures for construction activities, motor vehicles, and stationary sources. This chapter also describes methods for evaluating air quality impacts that are not easily quantified, such as impacts associated with objectionable odors.

Once the impacts of a proposed project have been identified, a determination must be made as to whether the project would have a significant adverse impact on the environment. Significance criteria discussed in Chapter 2 of these Guidelines should be used in making this determination. For any potentially significant impacts, mitigation measures should be incorporated into the project to reduce the impact(s) to a level of insignificance. Chapter 4 provides guidance on mitigation measures.

CEQA requires that the project description include a list of agencies that are expected to use the EIR in their decision-making, and a list of the approvals for which the EIR will be used (State CEQA Guidelines Section 15124(d)). If the project will require a permit from the District, all applicable District regulations should be cited in the project description section of the EIR.

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[11] This chapter discusses how to evaluate the air quality impacts of development projects and plans. For the sake of brevity, this chapter generally refers only to "project(s)". The reader should note, however, that unless specifically noted otherwise, the discussion also addresses plans.

3.2 Environmental Setting

In order to assess whether a proposed project would have a significant air quality impact, it is necessary to prepare a detailed description of the environmental setting in which the project would be located. Developing the environmental setting, or baseline, is necessary for establishing a basis for comparing the project's subsequent air quality impacts. With respect to air quality impacts, the description of the project's environmental setting should include the following components:

- Climate and topography influencing the project's impacts on local and regional air quality should be described. Appendix D provides an overview of how climate and topography affect air quality conditions. Appendix D also provides more detailed information on climate, topography and pollution potential for various climatological subregions in the Bay Area.

- Existing air quality conditions should be described. A discussion of trends and expected future conditions (without the project) also should be included. Data from the air quality monitoring station(s) closest to the project site should be included. Appendix C provides ambient air quality monitoring data. Appendix C also provides projections of expected emissions for future years.

- Any sensitive receptors located near the project site should be identified. Areas that are currently undeveloped but that may include sensitive receptors in the future, for example a future school site or residential area, also should be identified.

- Sources of air pollutants located near the project site (including existing sources *at* the project site, if applicable) should be identified. The description of existing air pollution sources should include criteria pollutants, toxic air contaminants and nuisance emissions such as odors and dust. More detailed information regarding existing emissions, including emissions of odors and toxic air contaminants, may be obtained by contacting the District.

- The transportation system serving the project site should be described. Describe traffic conditions, including traffic volumes and levels of service; transit service; and other relevant transportation facilities such as bicycle facilities, shuttle services, telecommuting centers, etc. The discussion of the existing transportation system should describe both current conditions and future conditions without the project.

- Any special circumstances, such as sources of odors, toxic air contaminants or accidental releases of hazardous materials located near the project site, should be described.

Special emphasis should be placed on air quality resources that are rare or unique to the region and would be affected by the project (State CEQA Guidelines Section 15125 (a)). Regulatory requirements identify areas which are pristine and classified as Class I airsheds. These airsheds are subject to specific standards (Prevention of Significant Deterioration requirements). Within the Bay Area, the Point Reyes National Seashore is designated as a Class I area. Projects

proposed in the vicinity of that area should note the project's proximity to a Class I area in the description of the project setting.

3.3 Evaluating Construction Emissions

Construction activities result in air pollutant emissions and should be addressed in environmental documents. Although construction-related emissions are generally temporary in duration, they can be substantial and can represent a significant impact on air quality. This is particularly true with respect to emissions of PM_{10}. Construction-related emissions come from a variety of activities including: 1) grading, excavation, roadbuilding and other earthmoving activities, 2) travel by construction equipment, especially on unpaved surfaces, and 3) exhaust from construction equipment. Demolition of buildings also generates PM_{10} emissions, and is of particular concern if the building(s) contain any asbestos-bearing materials.

PM_{10} emissions from construction activity can vary considerably depending on factors such as the level of activity, the specific operations taking place, and weather and soil conditions. As noted in Section 2.3, the District emphasizes implementation of effective and comprehensive control measures rather than detailed quantification of construction emissions. The District urges Lead Agencies to consider the size of the construction area and the nature of the activities that will occur, and require the implementation of all feasible control measures (indicated in Table 2).

If a Lead Agency wants to quantify construction emission, however, generalized emission factors are available. U.S. EPA has developed an approximate emission factor for construction-related emissions of total suspended particulate of 1.2 tons per acre per month of activity. This factor assumes a moderate activity level, moderate silt content in soils being disturbed, and a semi-arid climate. ARB estimates that 64% of construction-related total suspended particulate emissions is PM_{10}.[12] This yields the following **emission factors for uncontrolled construction-related PM_{10} emissions:**

- 0.77 tons per acre per month of PM_{10}, or
- 51 lbs per acre per day of PM_{10}.[13]

The emission factors provided above are approximate values and do not reflect site-specific conditions and operations. EPA recommends that if construction emissions from a specific site are to be quantified, the construction process should be divided into component operations (e.g., bulldozing, loading of excavated materials, vehicular traffic, etc.) and more specific emission factors should be used. See Section 13.2.3, Heavy Construction Operations, and related sections of U.S. EPA, Compilation of Air Pollutant Emission Factors, Volume I: Stationary, Point and Area Sources, AP-42, 5th Edition, January 1995 for further information.

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[12] California Air Resources Board, Methods for Assessing Area Source Emissions in California, September 1991.
[13] EPA's emission factor was derived based on the assumption that construction activity occurs 30 days per month. See Section 13.2.3, Heavy Construction Operations, U.S. EPA, Compilation of Air Pollutant Emission Factors, Volume I: Stationary, Point and Area Sources, AP-42, 5th Edition, January 1995.

In addition to particulate emissions from earthmoving, air pollutants also are emitted in the exhaust of construction equipment. Table 7 presents emission factors for estimating construction equipment emissions (assuming an average of 0.27 gallons of fuel burned per cubic yard of earth moved). These emission factors represent a composite fleet of heavy and light duty construction equipment in the Bay Area. Emissions from construction equipment during building construction, as differentiated from earthmoving in site preparation, vary greatly from project to project. Table 7 can be used to estimate construction exhaust emissions based on gallons of fuel consumed or cubic yards of material moved. Lead Agencies also may consult the most recent edition of U.S. EPA's AP-42 for emission factors for specific types of construction equipment.

TABLE 7
HEAVY AND LIGHT DUTY CONSTRUCTION EQUIPMENT EXHAUST EMISSION FACTORS

Contaminant	gm/yd^3*	gm/gallon**
PM_{10}	2.2	8.0
CO	138.0	511.0
ROG	9.2	34.0
NO_x	42.4	157.0
SO_x	4.6	17.0

* Grams per cubic yard of earth moved.
** Grams per gallon of fuel burned.

Project construction sometimes involves the demolition of existing buildings. Demolition also produces PM_{10} emissions. PM_{10} emissions from demolition activities may be estimated using the following emission factor: 0.00042 lbs PM_{10} per cubic feet of building volume.[14] Buildings constructed prior to 1980 often include building materials containing asbestos. As noted in Section 2.3, Thresholds of Significance, the demolition, renovation or removal of asbestos-containing building materials is subject to District Regulations. The District's Enforcement Division should be consulted prior to commencing demolition of a building containing asbestos building materials.

The emission factors provided above represent uncontrolled emissions. Section 2.3, Thresholds of Significance, and Section 4.2, Mitigating Construction Impacts, provide information on mitigating construction-related emissions. If an environmental document will include quantification of construction emissions, the Lead Agency should be sure to apply the estimated control effectiveness to the appropriate emission source. For example, watering a construction site can reduce PM_{10} emissions from earthmoving activities, but will not reduce equipment exhaust emissions.

[14] South Coast Air Quality Management District, CEQA Air Quality Handbook, April 1993.

3.4 Calculating Emissions from Project Operations

Introduction

Several types of emissions should be considered when evaluating the impacts of a project's operations. For many types of land use development projects, the principal sources of air pollutant emissions are the motor vehicle trips generated by the project. These are often referred to as "indirect sources" and include projects such as shopping centers, office buildings, arenas and residential developments. The evaluation of an indirect source's impact should consider localized pollutants such as carbon monoxide and PM_{10}, as well as regional pollutants such as ozone. This section describes methods for estimating total project emissions from motor vehicles (see "Calculating Mobile Source Emissions"), as well as methods for estimating localized CO concentrations (see "Calculating Carbon Monoxide Concentrations").

Most land use projects also generate "area source" emissions. Area sources are sources that individually emit fairly small quantities of air pollutants, but which cumulatively may represent significant quantities of emissions. Water heaters, fireplaces, lawn maintenance equipment, and application of paints and lacquers are examples of area source emissions.

Certain projects also may generate stationary, or "point", source emissions. Although most area sources discussed above are usually stationary, the terms stationary or point source usually refer to equipment or devices operating at industrial and commercial facilities. Examples of facilities with stationary sources include manufacturing plants, quarries, print shops and gasoline stations.

Depending on the nature of the proposed project and/or the land uses near the project site, other air quality impacts associated with project operation may arise. These impacts include odor problems, emissions of toxic air contaminants and accidental releases of hazardous/toxic materials. Most of this chapter addresses the evaluation of the impacts a project would have on the surrounding environment. However, with respect to potential impacts related to odors, toxics, and accidental releases it is equally important to also consider the impact of the surrounding environment on the proposed project. For example, if a residential development were proposed for a site near an existing wastewater treatment plant, exposure of the new residents to objectionable odors would be a significant air quality impact associated with the project.

Calculating Mobile Source Emissions

As noted above, virtually all land use development projects result in indirect source emissions due to the motor vehicle trips generated by the project. The following discussion describes how to calculate these emissions.

Whenever possible, the air quality impact analysis for a project should be based on the results of a traffic study conducted specifically for the project. The number of vehicle trips that a project will generate, and the average speed and length of the trips, will vary depending on a variety of factors such as the specific nature of the project and its location. If project-specific data are not

available, then the default values provided in this chapter may be used. The most recently published set of trip generation rates from the Institute of Transportation Engineers (ITE) also may be used.

Transportation analyses for projects consisting of two or more land uses often adjust the number of anticipated new vehicle trips to account for internal trips. These adjustments (or "capture rates") reflect the fact that some trips at multi-use projects will occur internally to the project. As a result, the total number of new vehicle trips associated with the project would be less than the sum of the trips expected from all of the individual land uses. Traffic studies for such projects should include a clear explanation of all capture rate assumptions. Internal trips should be excluded from the air quality analysis only if they are expected to occur by walking, bicycling or other nonpolluting mode.

Traffic studies for commercial projects often distinguish between primary trips and pass-by and diverted linked trips.[15] The air quality analysis for such projects should include emissions from pass-by and diverted linked trips. While the emissions from these trips will be lower than for primary trips (due to shorter trip lengths), they still do produce emissions (trip end emissions and some running emissions). Adjustments can be made to trip length and cold start/hot start assumptions for pass-by and diverted linked trips. Assumptions regarding pass-by and diverted linked trips should be clearly identified and the underlying rationale explained.

ARB calculates emission factors for motor vehicles using the EMFAC computer program. ARB periodically revises EMFAC emission factors. At the time of this writing (April 1996), the most current set of motor vehicle emission factors is EMFAC7F, Version 1.1. The composite emission factors provided in these Guidelines (Table 10) are based on EMFAC7F1.1. The differences between successive versions of EMFAC can lead to significant variation in estimates of mobile source emissions calculated using these emission factors. As future revisions to EMFAC are approved by ARB, the District will revise the composite emission factors in Table 10. Lead Agencies should always use the most recent emission factors prepared by the District.

URBEMIS5

The Air Resources Board has developed the URBEMIS5 program to calculate mobile source emissions associated with various types of land use projects. URBEMIS5 uses EMFAC7F1.1 emission factors and ITE trip generation rates. The program provides default values for all modeling parameters for several regions within California, including the San Francisco Bay Area. The user may use the default values or may provide project-specific values for parameters including trip generation, trip length, trip speed, vehicle fleet mix, percentage of cold starts, and temperature. URBEMIS5 calculates emissions of total organic gases (TOG), NO_x, CO, PM_{10} and SO_x, as well as total vehicle trips and gallons of fuel used.

[15] Primary trips are trips made specifically to visit a particular facility. Pass-by trips are trips made as intermediate stops on the way to a primary trip destination. Diverted linked trips are trips attracted from roadways near a facility, but which require a diversion from the roadway to another roadway to access the facility.

URBEMIS5 is a sketch planning tool for calculating criteria air pollutant emissions from land use development projects. URBEMIS5 is not appropriate for calculating air pollutant emissions associated with plans. Other models, such as the Direct Travel Impact Model (DTIM), may be used to quantify (mobile source) air pollutant emissions associated with plans.

Several important characteristics of URBEMIS5 should be noted:

1) URBEMIS5 only calculates tailpipe and tire wear emissions of PM_{10}, and does not calculate PM_{10} emissions from entrained road dust. Entrained road dust emissions of PM_{10} are significant and should not be neglected. These emissions must be calculated manually and added to the (partial) totals provided by URBEMIS5. In order to calculate PM_{10} emissions from entrained road dust, use an emission factor of 0.69 grams per mile.[16]

2) URBEMIS5 calculates emissions of total organic gases rather reactive organic gases (ROG). Because ROG is of greater concern with respect to ozone formation, TOG emissions provided by URBEMIS5 should be multiplied by 0.92 to arrive at mobile source ROG emissions from a proposed project.

3) Gasoline sold during winter months is formulated differently than gasoline sold during the summer. EMFAC7F1.1 emission factors account for seasonal differences in gasoline. As a result, URBEMIS5 only calculates daily emissions, and does not provide an annual total. (The URBEMIS5 Users' Guide provides guidance on estimating annual emissions.)

As noted above, URBEMIS5 allows the user to override the input assumptions provided in the model. The District recommends that the following input assumptions be used for projects in the San Francisco Bay Area. If project-specific travel data are available, that data should be used. The source(s) of any project-specific data should be described.

Recommended URBEMIS5 Inputs for the San Francisco Bay Area

Trip Generation - Use Table 8 or the most recent version of ITE's Trip Generation manual if project-specific data are not available.

Fleet Mix - Use the default values for the San Francisco Bay Area.

Season - Use summer for all pollutants except CO. Use winter for CO.

Temperature - Meteorological conditions in the Bay Area vary considerably between climatological subregions. Refer to Appendix D for subregional information. Use mean summer

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16 Assumes: a) TSP emissions of entrained road dust of 3.57 grams per mile, and b) 19% of TSP entrained road dust is PM_{10}.

maximum temperatures for all pollutants except CO. Use mean winter minimum temperatures for CO.

Trip Length - Use the data in Table 9 or the most recent edition of MTC's Bay Area Travel Forecasts if project-specific data are not available.

Percent Hot/Cold Start - Use 40% hot starts and 60% cold starts.

Trip Speed - Use 25 mph for San Francisco and 30 mph for all other Bay Area counties if project-specific data are not available.

Percent Trip - Use the default values for the San Francisco Bay Area if project-specific data are not available.

In August 1995 ARB released URBEMIS5, which is an update of the previous version, URBEMIS3. Because URBEMIS5 includes more current emission factors (EMFAC7F1.1), as well as other improvements, *older versions of URBEMIS should not be used* to estimate mobile source emissions.

Manual Calculation

The District has developed a methodology for manually calculating mobile source emissions associated with land use development. For this calculation it is necessary to provide the following inputs: trip generation rate, average trip length and emission factors (varying by average vehicle speed and analysis year).

As previously noted, project-specific traffic data should be used in the air quality analysis whenever it is available. If project-specific data are not available, the default values provided in these Guidelines may be used. Table 8 provides trip generation rates for various types of land uses. The trip generation rates provided in Table 8 are based on data in the Institute of Transportation Engineers (ITE) Trip Generation, 5th Edition, 1991. For land use projects not included in Table 8 and for which project-specific data are not available, consult the most recent edition of ITE's Trip Generation manual.

Table 9 provides average trip lengths for each of the nine Bay Area counties. These trip lengths were derived from MTC travel data used by the District in the preparation of the Bay Area mobile source emission inventory.

Table 10 provides emission factors, based on EMFAC7F, Version 1.1. The emission factors in Table 10 are based on a standardized mix of hot start, cold start and hot stabilized emissions representative of Bay Area driving conditions and the District's emission inventory. The emission factors also include the benefits of the 1995 motor vehicle Inspection and Maintenance program and reformulated fuels requirements.

TABLE 8
AVERAGE TRIP GENERATION RATES
FOR SELECTED LAND USES

LAND USE	UNIT OF MEASURE	TRIP RATE	LAND USE	UNIT OF MEASURE	TRIP RATE
RESIDENTIAL			***INDUSTRIAL***		
Single Family Home	D.U.	9.6	Light Industrial	1000 GSF	7.0
Apartment	D.U.	6.5	Industrial Park	1000 GSF	7.0
Res. Condominium	D.U.	5.9	Manufacturing	1000 GSF	3.9
Mobile Home Park	D.U.	4.8	Warehousing	1000 GSF	4.9
RETAIL			Mini Warehouse	1000 GSF	2.6
Discount Store (Saturday)	1000 GFA	72.7	***OFFICE***		
Shopping Ctr.-Regional (>600,000 sq. ft.)	1000 GFA	36.3*	General Office-Large (>300,000 sq. ft.)	1000 GSF	9.5*
Shopping Ctr.-Comm. (200,000-600,000 sq. ft.)	1000 GFA	54.6*	General Office-Medium (50,000-300,000 sq. ft.)	1000 GSF	14.0*
Shpg. Ctr.-Neighborhood (<200,000 sq. ft.)	1000 GFA	118.4*	General Office-Small (<50,000 sq. ft.)	1000 GSF	19.7*
Supermarket (Saturday)	1000 GSF	177.6	Corp. Headquarters Bldg.	1000 GSF	6.3
Convenience Market (24 hour) (Saturday)	1000 GSF	863.1	Medical Office Bldg.	1000 GSF	34.2
INSTITUTIONAL			Office Park	1000 GSF	11.4
Elementary School	1000 GSF	10.7	Gov't Office Complex	1000 GSF	25.0
High School	1000 GSF	10.9	Research Center	1000 GSF	7.7
Community College	1000 GSF	12.9	Business Park	1000 GSF	14.4
Church (Sunday)	1000 GSF	36.6	***RECREATIONAL***		
Hospital	1000 GSF	16.8	Movie Theater (w/Matinee) (Saturday)	screen	529.5
Library	1000 GSF	45.5	Racquet Club	1000 GSF	17.1
Post Office	1000 GSF	87.1	Golf Course	Acre	8.3
LODGING					
Hotel	Room	8.7			
Motel	Room	10.2			

GSF = Gross Square Feet; GLA = Gross Leasable Area; GFA = Gross Floor Area; D.U. = Dwelling Unit
* = Generalized estimate. Trip rate will vary depending upon size of project. See the most recent edition of Trip Generation, Institute of Transportation Engineers.

Source: Institute of Transportation Engineers, Trip Generation, 5th Ed. 1991, and February 1995 Update.

TABLE 9
AVERAGE TRIP LENGTH (in miles)
BY COUNTY AND YEAR

County	1990	1995	2000	2005	2010
Alameda	7.7	7.9	7.9	7.8	7.8
Contra Costa	7.4	7.6	7.7	7.7	7.8
Marin	7.9	7.7	7.7	7.8	7.8
Napa	5.7	5.9	6.2	6.4	6.6
San Francisco	6.4	6.4	6.4	6.3	6.3
San Mateo	7.3	7.3	7.5	7.7	7.9
Santa Clara	6.4	6.6	6.9	7.3	7.6
Solano	10.4	10.0	9.6	9.4	9.2
Sonoma	6.0	6.0	6.0	6.1	6.1
District Average	7.1	7.2	7.4	7.5	7.6

Average trip lengths are based on MTC data used in preparation of Bay Area mobile source emission inventory.

TABLE 10
COMPOSITE EMISSION FACTORS BY POLLUTANT AND SPEED
(grams/mile)

	Average Speed (miles per hour)												
Pollutant	5	10	15	20	25	30	35	40	45	50	55	60	65
- 1990 -													
Carbon Monoxide	103.57	53.85	36.34	27.69	22.50	18.95	16.36	14.74	13.20	12.59	12.83	16.92	31.85
Reactive Organic Gases	8.30	4.30	2.82	2.11	1.71	1.43	1.20	1.02	0.89	0.81	0.80	1.02	2.19
Nitrogen Oxides	3.35	2.44	2.00	1.74	1.58	1.51	1.51	1.58	1.72	1.95	2.29	2.72	3.26
Sulfur Oxides	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Particulate Matter (PM_{10})	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
- 1995 -													
Carbon Monoxide	66.40	34.80	23.52	17.90	14.53	12.25	10.60	9.40	8.61	8.25	8.50	10.85	19.30
Reactive Organic Gases	6.70	3.17	1.96	1.43	1.15	0.97	0.83	0.71	0.63	0.58	0.59	0.74	1.45
Nitrogen Oxides	2.68	1.95	1.59	1.37	1.24	1.18	1.18	1.23	1.34	1.52	1.78	2.11	2.53
Sulfur Oxides	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Particulate Matter (PM_{10})	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
- 2000 -													
Carbon Monoxide	43.93	22.99	15.52	11.76	9.51	8.00	6.92	6.13	5.60	5.33	5.41	6.49	10.51
Reactive Organic Gases	4.82	2.14	1.26	0.89	0.70	0.59	0.50	0.44	0.39	0.37	0.38	0.47	0.85
Nitrogen Oxides	2.03	1.48	1.20	1.03	0.93	0.88	0.88	0.92	1.01	1.14	1.33	1.57	1.89
Sulfur Oxides	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Particulate Matter (PM_{10})	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
- 2005 -													
Carbon Monoxide	27.59	14.76	10.00	7.57	6.11	5.14	4.46	3.99	3.68	3.55	3.68	4.37	6.73
Reactive Organic Gases	3.32	1.45	0.84	0.58	0.46	0.38	0.33	0.29	0.26	0.25	0.25	0.31	0.54
Nitrogen Oxides	1.70	1.25	1.02	0.88	0.79	0.75	0.75	0.78	0.85	0.96	1.11	1.32	1.58
Sulfur Oxides	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Particulate Matter (PM_{10})	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
- 2010 -													
Carbon Monoxide	19.80	10.81	7.35	5.56	4.48	3.78	3.29	2.96	2.76	2.70	2.85	3.39	5.06
Reactive Organic Gases	2.27	1.00	0.58	0.41	0.32	0.27	0.23	0.21	0.19	0.18	0.18	0.22	0.35
Nitrogen Oxides	1.51	1.12	0.92	0.79	0.71	0.68	0.67	0.70	0.76	0.86	0.99	1.17	1.41
Sulfur Oxides	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Particulate Matter (PM_{10})	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82

Notes:

1) Emission rates from CARB's EMFAC7F Final Version 1.1 (1/94).
2) Fleet mix as per CARB's BURDEN7F Final (January 1994).
3) Inspection and Maintenance Program effectiveness included.
4) Ambient temperature assumed: 75 F for ROG, NOx, SOx, PM_{10}; 55 F for CO.
5) ROG emission rates include evaporative running loss emissions.
6) Emission rates include cold and hot start emissions consistent with Bay Area driving conditions.
7) Particulate matter emission rates include exhaust, tirewear and entrained road dust emissions.

Mobile source emissions from land use projects may be calculated using the equation provided below. A separate calculation must be made for each pollutant.

$$E = (U \times T) \times [(L \times R) + S]$$

Where:

E equals total emissions (of each pollutant), in grams per day;

U equals number of units in the project, e.g. number of dwelling units or thousands of square feet in shopping center buildings (see units in Table 8);

T equals trip generation rate, or average trips per day generated per unit of land use (Table 8);

L equals average trip length, in miles per trip (Table 9);

R equals motor vehicle emission rate, or emission factor, for each pollutant, by average vehicle speed and analysis year (Table 10);

S equals trip end, or "hot soak", emissions (ROG only) (Table 11).

To convert grams per day to pounds per day, divide the total by 454. To convert grams per day to tons per day, divide the total by 908,000.

TABLE 11
HOT SOAK EMISSION FACTORS

Year	ROG Emissions (grams/trip)
1990	1.75
1995	0.87
2000	0.45
2005	0.30
2010	0.21

Calculating Carbon Monoxide Concentrations

Emissions and ambient concentrations of carbon monoxide have decreased greatly in recent years. These improvements are due largely to the introduction of cleaner burning motor vehicles and motor vehicle fuels. No exceedances of the State or national CO standard have been recorded at any of the region's monitoring stations since 1991. The Bay Area has attained the State CO standard and has requested the U.S. EPA to redesignate the region to an attainment area for the national CO standard.

Despite this progress, however, localized CO concentration still warrant concern in the Bay Area and should be addressed in environmental documents. The reasons for this are twofold. First, State and federal laws require the region to attain *and maintain* ambient air quality standards. The region must ensure that increased motor vehicle use and congestion do not nullify the great strides that have been made with respect to ambient concentrations of CO. Secondly, the region must safeguard against localized high concentrations of CO that may not be recorded at monitoring sites. Because elevated CO concentrations are generally fairly localized, heavy traffic volumes and congestion can lead to high levels of CO, or "hotspots," while concentrations at the closest air quality monitoring station may be below State and national standards.

A variety of computer models have been developed to estimate local CO concentrations resulting from motor vehicle emissions. One of the most common models is CALINE4, developed by and available from the California Department of Transportation. The District has developed a simplified screening method, which is based on CALINE4 and takes into account CO field studies conducted by the District in the Bay Area. The screening method enables the user to manually calculate local CO concentrations resulting from motor vehicles. Except for very large projects, the District recommends that the manual method be used to estimate CO concentrations. The resulting estimated CO concentrations should be compared to State and national CO standards to determine whether the project would have a significant air quality impact. If the results of the manual method indicate CO concentrations below the standards, then no further CO analysis is required. If the manual method predicts concentrations above the standards, the Lead Agency may either: make a finding of a significant impact and identify mitigation measures, or conduct a more detailed analysis using the CALINE4 model. Similarly, if the results of a CALINE4 analysis indicate a significant impact, mitigation measures should be identified. The effectiveness of any proposed mitigation measure(s) should be quantified by estimating the effects of the measure(s) on traffic volumes and/or speeds, and CO concentrations.

Manual Calculation of CO Concentrations

The following procedure is designed to provide a reasonable estimate of carbon monoxide concentrations near roads under worst case conditions. It is a simplified version of CALINE4. The District suggests that the full CALINE4 model be used, instead of this simplified formula, for any projects or plans that will generate 10,000 or more motor vehicle trips per day. The full CALINE4 model also may be used for smaller projects if the simplified screening method indicates that an air quality standard may be exceeded.

In the Bay Area, the highest CO concentrations usually occur in winter, on cold, clear days and nights with little or no wind. Low wind speeds inhibit horizontal dispersion and radiation inversions inhibit vertical mixing. Worst case conditions are built into the simplified model formula. Default conditions are as follows:

1. wind direction parallel to the primary roadway, 90° angle to secondary road;
2. wind speed less than 1 meter per second;
3. extreme atmospheric stability (class F);
4. receptor at edge of the roadway.

The carbon monoxide concentration, C, is the sum of a background value, C_o, and the total contribution from local traffic C_t,

$$C = C_o + C_t$$

The total contribution from local traffic, C_t, is the sum of the contributions from each contributing local road, C_i,

$$C_t = C_{i1} + C_{i2}$$

The contribution from one road, C_i, can be computed by the formula:

$$C_i = C_{ri} \times \frac{V_i \times EF_i}{V_r \times EF_r}$$

where:

C_{ri} is a reference case concentration for the i-th roadway,
V_r is the traffic volume for the reference case,
V_i is the traffic volume for the i-th roadway,
EF_r is the emission factor for the reference case,
EF_i is the emission factor for the i-th roadway,

Table 12 gives reference case concentrations for various road configurations with traffic volumes of 1000 vehicles per hour and emission factors of 100 grams per mile. The concentration relative to this reference case is then computed in parts per million (ppm), by the formula:

$$C_i = \frac{C_{ri} \times V_i \times EF_i}{100{,}000}$$

where Cr_i is taken from Table 12, V_i is the estimated traffic volume in vehicles per hour, and EF_i is the emission factor taken from Table 10 for the appropriate year of analysis and estimated traffic speed on this roadway.

The following discussion provides guidance on how to use the formulas provided above, and describes in detail each step of the manual method for calculating CO concentrations.

TABLE 12
REFERENCE CARBON MONOXIDE CONCENTRATIONS (ppm)

Roadway Type	Primary Road (Highest Volume Road)						Secondary Road (Intersecting Road)					
	(receptor distance from edge--in feet)											
At Grade	**At Edge**	**25'**	**50'**	**100'**	**300'**	**500'**	**At Edge**	**25'**	**50'**	**100'**	**300'**	**500'**
2 lane	14.0	7.6	5.7	4.0	1.7	0.9	3.7	2.7	2.2	1.7	1.0	0.8
4 lane	11.9	7.0	5.4	3.8	1.6	0.9	3.3	2.6	2.2	1.7	1.1	0.8
6 lane	9.5	6.1	4.9	3.5	1.6	0.8	2.8	2.3	2.0	1.7	1.1	0.9
8 lane	8.5	5.7	4.6	3.4	1.5	0.8	2.6	2.2	1.9	1.6	1.1	0.9
Depressed 15 feet												
2 lane	20.9	8.2	4.7	3.3	1.5	0.8	4.8	2.4	1.4	1.1	0.8	0.5
8 lane	15.4	6.3	3.6	2.7	1.3	0.7	3.7	1.9	1.1	1.0	0.7	0.6
Depressed 30 feet												
2 lane	26.8	7.9	3.4	1.7	0.8	0.3	5.2	3.2	2.0	0.8	0.4	0.3
8 lane	21.3	6.0	2.3	1.1	0.6	0.2	4.1	2.7	1.7	0.7	0.5	0.4
Elevated 15 feet												
2 lane	14.0	7.3	5.7	4.0	1.7	0.9	3.7	2.6	2.2	1.7	1.0	0.8
8 lane	8.5	5.4	4.6	3.4	1.5	0.8	2.6	2.1	1.9	1.6	1.1	0.9
Elevated 30 feet												
2 lane	14.0	7.3	5.4	4.0	1.7	0.9	3.6	2.6	2.2	1.7	1.0	0.8
8 lane	8.5	5.4	4.3	3.4	1.5	0.8	2.5	2.1	1.9	1.6	1.1	0.9

Notes: Normalized CO concentration is calculated based on the following assumptions: wind direction parallel to the highest volume roadway; wind speed less than 1 meter per second; extreme atmospheric stability (class F); receptor at edge of roadway; emission rate = 100 gm/mi.; vehicles per hour = 1,000; surface roughness = 100 cm; mixing cell width = roadway width (2 lane = 40 ft; 4 lane = 64 ft; 6 lane = 88 ft; 8 lane = 112 ft).

This simplified model was adapted from CALINE3 and CALINE4 (California Department of Transportation) by Mike Kim, Senior Transportation Engineer, BAAQMD.

<u>Step by Step Procedure for CO Analysis</u>

Make separate computations for current conditions, future no-project conditions (including cumulative), and future conditions with the project. For future year project and no-project conditions, select an analysis year corresponding to the estimated year of project completion. Also use the procedure to show the effects of mitigation measures, where such effects are quantifiable.

1. Identify intersections and/or roadway links that will be most impacted by the proposed project, according to the traffic impact analysis. An analysis should be made for each such intersection and link. (It would be helpful to include a map showing these points, in relationship to the project.)

2. Obtain peak-hour traffic volumes in both directions on each roadway considered for each year of consideration. If only average daily traffic is known, assume 10% for peak hour volumes. Use actual traffic counts, if available, for current year. Traffic levels for future years should include traffic generated by the proposed project plus other estimated growth distributed among roadway links.

3. Estimate average traffic speeds through the intersection for the peak hour on each roadway. (If future congestion is predicted, average speeds will decrease in future years.)

4. Obtain the CO emission factor for the speed on each roadway, for each relevant year from Table 10. (Interpolate if necessary.)

5. Determine the number of lanes and type of each roadway. (Do not count turning or parking lanes.) If the road is to be altered, use the appropriate width for the year being analyzed.

6. Based on the number of lanes, obtain the reference one hour concentration for each roadway from Table 12. The road with the most traffic should be considered the "Primary Road". Be careful to use the proper reference factor in the table if the receptor is not at the edge of the road or if one or both of the roadways is elevated or depressed.

7. Compute each roadway's contribution to the total concentration by use of the equation above. If modeling an intersection, add the concentrations of the two (or more) roadways.

8. Add the total roadway (local) contribution to the one hour background value from the background map (Figure 3) to obtain the estimated worst case concentration. Interpolate between isopleth lines and apply rollback factors for future years (Table 13) to determine the appropriate background value. Refer to the discussion below for guidance on determining background values.

9. To obtain the worst case eight hour concentration, multiply the one hour value for the local contribution by 0.7 (persistence factor). Add this derived eight hour local contribution to the eight hour background level (Figure 4). Interpolate between isopleth lines and apply rollback factors (Table 13) to determine the appropriate background value. Refer to the discussion below for guidance on determining background values.

Determining Background CO Concentrations

As noted above, estimating a project's impact on ambient CO concentrations involves adding the contribution from the project to existing background levels. Background carbon monoxide is defined as that part of the ambient CO concentration that is not attributable to traffic sources from a nearby street or intersection. Thus, during stagnant conditions, the background conditions at a site may include carbon monoxide emitted from outside the modeling area, as well as carbon monoxide emitted within the modeling area during the previous time periods.

In order to determine a reasonable background CO concentration, refer to Figures 3, 4 and 5 and Table 13. Figures 3 and 4 are isopleth maps of the Bay Area Air Basin showing estimated one hour and eight hour background CO values, respectively, in parts per million (ppm) for 1992. The maps are based on 1990 to 1992 CO concentration data from multiple monitoring sites of various types located throughout the region. Table 13 provides rollback factors to be used in conjunction with the isopleth maps when determining CO background concentrations for years beyond 1992. 1992 background values may be derived from the maps according to the following procedures, after first locating the project on the map.

If the project site happens to fall on an isopleth (contour) line, use the value marked for that line. If the project is determined to be between two different isopleth lines (i.e., between 3.0 and 6.0 or between 6.0 and 9.0 ppm), interpolate to select the appropriate intermediate value. Calculate the shortest distance to the lower and higher isopleths. Call these distances X and Y, respectively. Divide X by the sum of X + Y. Multiply this quotient by 3.0 ppm, and add this product to the lower isopleth value, I. This methodology is illustrated in Figure 5 and is represented by the following formula:

$$\{[X / (X+Y)] \times 3.0 \text{ ppm}\} + I_L = \text{CO background concentration in ppm, where}$$

I_L = the lower isopleth concentration
X = shortest distance to lower isopleth
Y = shortest distance to higher isopleth

TABLE 13
FUTURE YEAR CARBON MONOXIDE ROLLBACK FACTORS

*Rollback Factors to be used in conjunction with Figures 3 and 4 to determine one hour and eight hour average carbon monoxide background concentrations from 1993 to 2010**

Year	Rollback Factor
1992	1.0
1993	.97
1994	.94
1995	.90
1996	.87
1997	.84
1998	.81
1999	.78
2000	.75
2001	.73
2002	.70
2003	.67
2004	.65
2005	.63
2006	.62
2007	.60
2008	.59
2009	.59
2010	.58

*After the 1992 carbon monoxide background concentration has been determined, estimates of any year through 2010 can be made using the factors above. For the year desired, multiply the 1992 concentration times the appropriate factor. For example, if the 1992 concentration is 6.0 ppm, the 1999 concentration is calculated to be (6.0 ppm) x (.78) = 4.7 ppm.

Note: Ambient concentrations of carbon monoxide are expected to decline, *on average*, in future years. This will occur because emission controls on new vehicles will reduce CO emission rates faster than vehicle travel increases. (*Local* CO emissions and concentrations might increase under conditions of intense development and increasing travel. These procedures are intended to assess such situations.)

FIGURE 3

ONE HOUR CO BACKGROUND CONCENTRATIONS

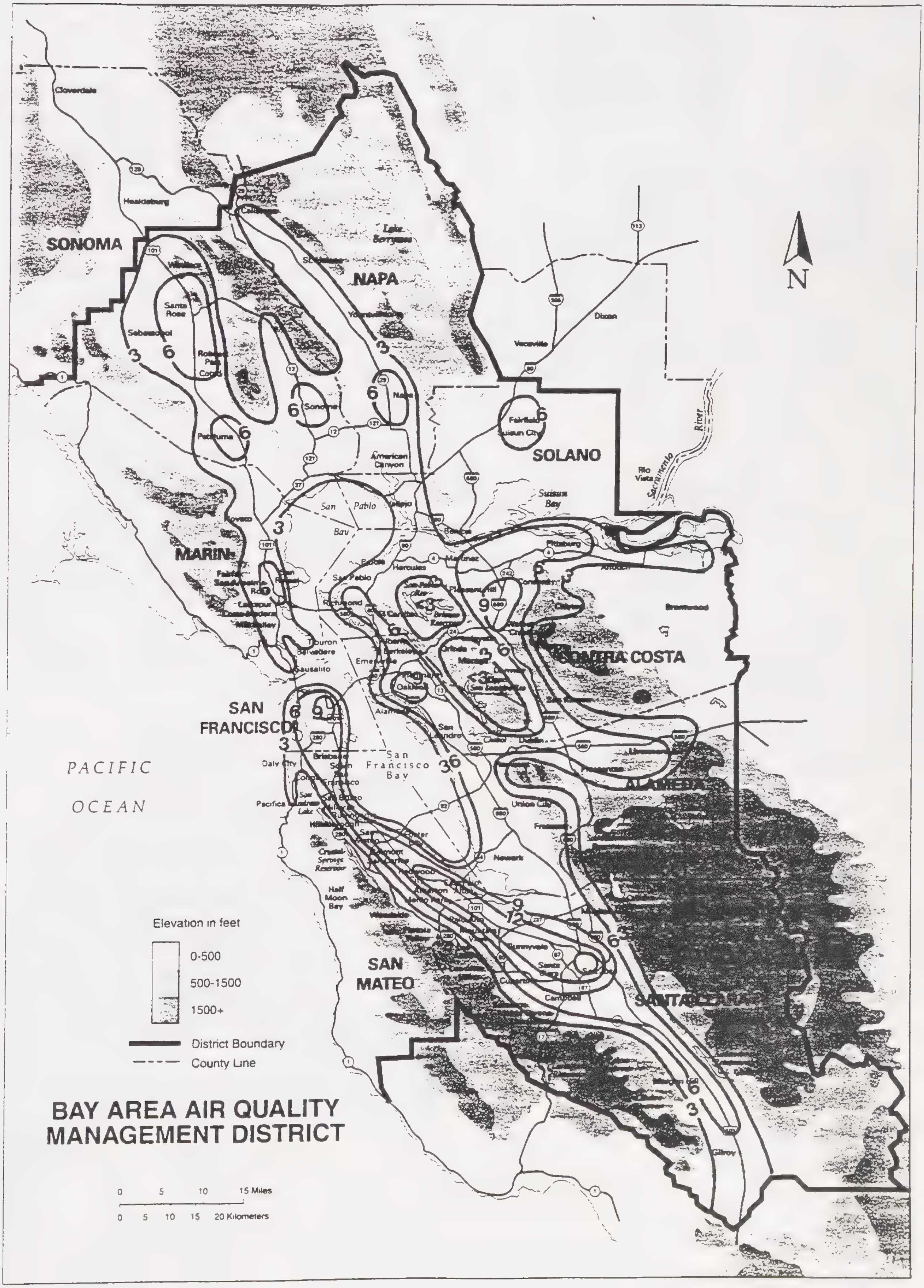


FIGURE 4

EIGHT HOUR CO BACKGROUND CONCENTRATIONS

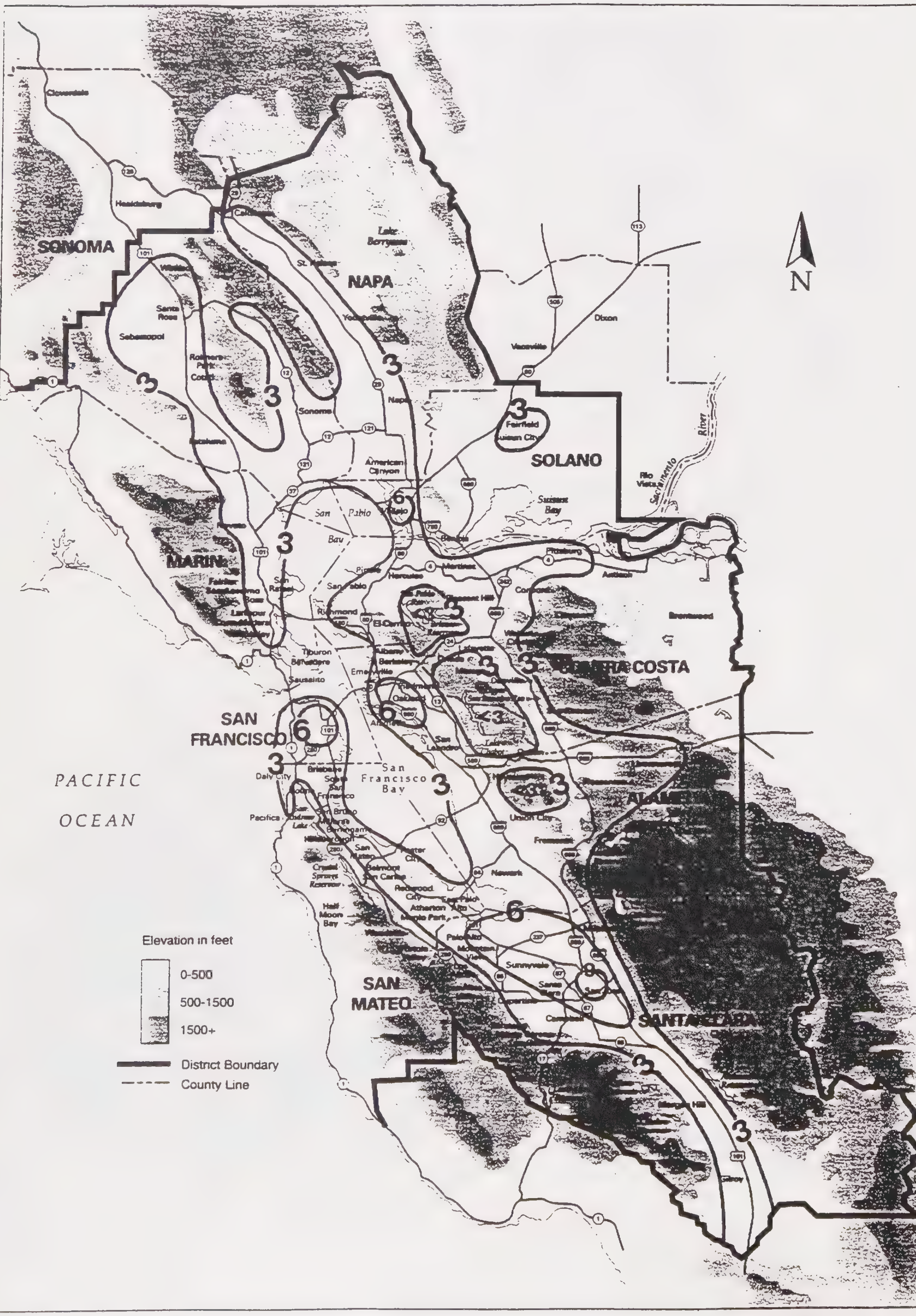
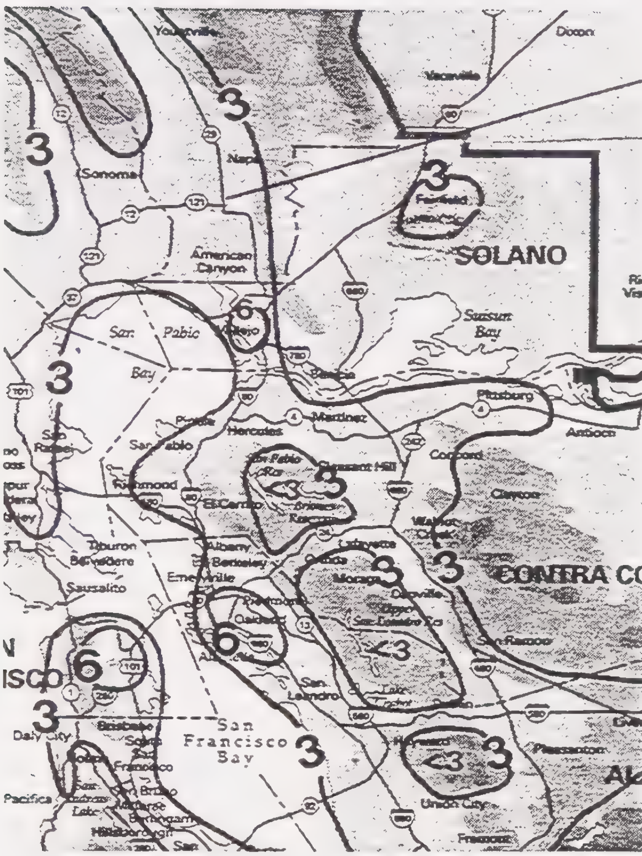


FIGURE 5

DETERMINING CO BACKGROUND CONCENTRATIONS EXAMPLE



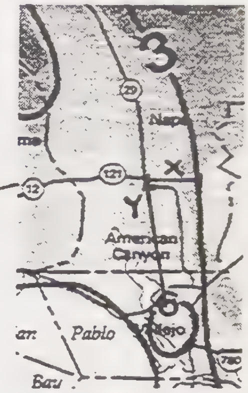


Figure 1A:

Intersection of Rtes. 29 and 121 in Napa County: An intersection project at this location would be between the 3.0 and 6.0 isopleths. The shortest distance to the 3.0 isopleth is represented by line segment X, and measures 5mm. The shortest distance to the 6.0 isopleth is represented by line segment Y, and measures 13mm. The background concentration for the project would thus be found as follows:

(5mm)/(5mm + 13mm) = 5/18 = .28

(.28)(3.0 ppm) + 3.0 ppm = the background concentration = 3.83 ppm

Figure 1B:

Project on I-680 in San Ramon:
A project on this section of interstate would be between the 3.0 and 6.0 isopleths. The shortest distance to the 3.0 isopleth is represented by line segment X, and measures 2mm. (Note that the project is roughly equidistant from 2 distinct 3.0 isopleths. One is due east, and one is due west.) The shortest distance to the 6.0 isopleth is 23mm. The background concentration for the project would thus be found as follows:

(2mm)/(2mm + 23mm) = 2/25 = .08

(.08)(3.0 ppm) + 3.0 ppm = the background concentration = 3.24 ppm

Figure 1C:

Project on I-980 in Oakland roughly intermediate between I-580 and I-880:
Such a project is located within a peak on the map. The shortest distance to the 6.0 isopleth forming the boundary of the peak is 2mm, and is represented by the line segment X. The distance to the centroid is also 2mm, and is represented by line segment Z. The background concentration for the project would be calculated as follows:

(2mm)/(2mm + 2mm) = 2/4 = .5

(.5)(2.9 ppm) + 6.0 ppm = the background concentration = 7.5 ppm

If the project is located within a "peak" on the map (i.e., within an enclosed area free of a higher isopleth), use the following procedure. (Such a peak could be above a 3.0, 6.0 or 9.0 ppm isopleth.) Measure the shortest distance to the isopleth forming the boundary of the peak. Call this distance X. Measure the distance to the centroid of the enclosure. Call this distance Z. Divide X by the sum of X + Z. Multiply this quotient by 2.9 ppm, and add this product to the boundary isopleth value, I_B. This methodology is illustrated in Figure 5 and is represented by the following formula:

$$\{[X / (X + Z)] \times 2.9 \text{ ppm}\} + I_B = \text{CO background concentration in ppm, where}$$

I_B = boundary isopleth concentration
X = shortest distance to boundary isopleth
Y = distance to centroid

For projects located in areas of the map below the 3.0 isopleth, a background concentration of 2.5 ppm should be assumed.

Example Calculation

Situation: Analysis year: 2000

Intersection of 6-lane highway and a 4-lane road at grade level.

Receptor point at edge of roadway.

Background one hour CO concentration is 9.0 ppm.

Background eight hour CO concentration is 6.0 ppm.

	Primary Road	Secondary Road
Hourly Traffic Volume	3400	2700
Average Speed	35 mph	20 mph
Equation	$\frac{(9.5)(3400)(6.92)}{100,000}$	$\frac{(3.3)(2700)(11.76)}{100,000}$

1-Hr Local Concentration: 2.2 + 1.1 = 3.3 ppm

1-Hr Total Concentration: 3.3 (intersection) + 9.0 (1-hr background) = 12.3 ppm

8-Hr Local Concentration: (3.3) x (.7) = 2.3 ppm

8-Hr Total Concentration: 2.3 (intersection) + 6.0 (8-hr background) = 8.3 ppm

Estimating Stationary Source Emissions

Environmental documents for proposed stationary sources of air pollutants should include a detailed analysis of the project's emissions of criteria pollutants and toxic air contaminants. The document also should describe District regulations applicable to the project and summarize how project design and operations will comply with applicable regulations. Lead Agencies should consult the District's Permit Services Division for guidance on calculating emissions from stationary sources of air pollutants.

For stationary sources being evaluated at an early planning stage, only a general planning or zoning classification may be available, e.g. "research and development" or "light industry". Assignment of specific emission factors may be difficult. In such cases, the best estimate of future uses should be made. Where an industry designation like "electronic components" or "food processing" is known, or assumed, generalized emission factors may be used. Table 14 provides generalized estimates of air contaminant emissions for a number of categories of industrial and related land uses found in the San Francisco Bay Area. These generalized emission factors are expressed in terms of pounds of contaminant per acre per day. These factors were derived from information in the District's emission inventory files. Caution should be exercised in using these figures because of the wide diversity of facility types under each of the categories. However, they may be valuable as first estimates of contaminant levels to be expected when only the general category of development is known.

These estimates do not include emissions that can be expected from motor vehicles attracted to these facilities. The indirect source emissions should be calculated separately, as explained earlier in this chapter. Total emissions generated by a proposed project would be the sum of the direct and indirect emissions calculated.

3.5 Evaluating Odor Impacts

As noted in Chapter 2, an analysis of potential odor impacts should be conducted for both of the following situations: 1) a potential source of objectionable odors is proposed for a location near existing sensitive receptors, *and* 2) sensitive receptors are proposed to be located near an existing source of objectionable odors. Section 2.3 discusses thresholds of significance for odor impacts.

Odor problems vary greatly. The occurrence and severity of odor impacts depends on numerous factors, including: the nature, frequency and intensity of the source; wind speed and direction; and the sensitivity of the receptor(s). Therefore, to the extent feasible, the analysis of potential odor impacts should be based on District experience and data regarding similar facilities in similar settings. Lead Agencies should consult the District's Enforcement Division for information regarding specific facilities and categories of facilities, and associated odor complaint records.

TABLE 14
GENERALIZED EMISSION FACTORS
FOR SELECTED INDUSTRY GROUPS*

Industry Group (Sub-groups)	Average Emissions per Facility (lbs/acre/day)				
	Part.	Org.**	NO_x	SO_2	CO
Manufacturing					
Food Canning (2032, 2033)	0.3	0.5	19.0	22.0	2.2
Paper Prod.(2643, 2647, 2649, 2653, 2654)	0.2	4.4	2.8	0.01	0.6
Printing & Publishing (2700-2771)	3.5	31.0	42.0	0.2	6.0
Inorganic Chemicals (2812, 2813, 2816, 2819)	1.6	0.6	4.9	2.6	5.9
Paints, Varnishes, etc. (2851)	0.2	20.0	0.5	0.0	0.1
Organic Chemicals (2861, 2865, 2869)	1.4	8.5	3.0	0.5	1.6
Petroleum Refining (2911)	1.4	18.0	26.0	16.0	1.3
Paving & Roofing (2951, 2952)	17.0	1.9	11.0	0.7	5.3
Plastic Products, Misc. (3079)	1.1	51.0	0.6	0.0	0.1
Stone, Clay, Glass & Concrete Prod. (3200-3299)	14.0	2.4	17.0	4.6	3.0
Iron & Steel Foundries (3321, 3324, 3325)	11.0	44.0	5.0	2.8	23.0
Metal Containers (3411, 3412)	0.5	90.0	5.5	0.03	0.8
Heating Equipment (3433)	0.1	2.7	0.2	0.00	0.03
Metal Work (3443, 3444, 3448, 3449)	5.3	11.0	1.3	0.01	0.2
Metal Coating (3471, 3479)	0.3	13.0	0.8	0.00	0.1
Machinery, except electrical (3500-3599)	72.0	23.0	0.5	0.02	0.1
Semiconductors, etc. (3674)	0.1	32.0	0.3	0.01	0.1
Electronic Components (3679)	0.1	5.6	0.1	0.00	0.02
Instruments (3800-3873)	0.3	23.0	1.4	0.01	0.2
Other					
Electric Utility plus Other Services (4931)	17.0	12.0	410.0	78.0	32.0
Petroleum Bulk Stations & Terminals (5171)	0.01	150.0	0.1	0.02	0.01
Dry Cleaning Plants (7216)	0.00	6.6	0.1	0.00	0.01
General Hospitals (8062)	2.9	2.3	30.0	0.2	6.0
National Security (9711)	2.8	2.5	22.0	0.01	5.5

*Based on U.S. Standard Industrial Classification (S.I.C.) Code groupings. As compiled by the Statistical Policy Division, Office of Management and Budget.

**Table lists total organic gases (TOG). Reactive organic gases (ROG) is virtually the same for the industrial categories.

Any project that would result in an odor source and sensitive receptors being located closer to one another than the distances indicated in Table 4 should be subjected to a more detailed analysis. (Table 4 lists types of facilities that commonly emit objectionable odors.) For any projects triggering the screening level distances in Table 4, the District's Enforcement Division should be contacted for information regarding odor complaints. For projects involving a new receptor being located near an existing odor source(s), the District's inventory of odor complaints for the nearest odor emitting facility(ies) should be reviewed for the previous three years. Odor complaints should be mapped in relation to the odor source to establish a general boundary of any existing impacts.[17] The location of the proposed project should be identified.

For projects involving new receptors locating near an existing odor source where there is currently no nearby development, and for new odor sources locating near existing receptors, the analysis should be based on a review of odor complaints for similar facilities.

In assessing potential odor impacts, consideration also should be given to local meteorological conditions, particularly the intensity and direction of prevailing winds. Refer to Appendix D or contact the District for local meteorological data.

3.6 Evaluating Impacts of Toxic Air Contaminants

The District limits emissions of and public exposure to toxic air contaminants (TACs) through a number of programs. TAC emissions from new and modified stationary sources are limited through an air toxics new source review program, which implements the District's Risk Management Policy via the District's permitting process for stationary sources. TAC emissions from existing sources are limited by: 1) District adoption and enforcement of rules aimed at specific types of sources known to emit high levels of TACs (e.g., chrome plating operations), and 2) implementation of the Air Toxics "Hot Spots" (AB 2588) Program. Appendix E provides more detailed information on District air toxics programs.

When considering potential impacts related to TACs, Lead Agencies should consider both of the following situations: 1) a new or modified source of TACs is proposed for a location near an existing residential area or other sensitive receptor, and 2) a residential development or other sensitive receptor is proposed for a site near an existing source of TACs.

For the first scenario, a source of TACs proposed near sensitive receptors, the Lead Agency should consult with the District's Toxics Evaluation Section for information regarding anticipated TAC emissions, potential health impacts and control measures. Preparation of the environmental document should be closely coordinated with the District review of the facility's permit application.

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17 Due to confidentiality requirements regarding odor complaints, only the block number will be provided for mapping. The name of the complainant, date of complaint, and specific address of the complainant will not be provided.

For the second scenario, sensitive receptors locating near sources of TACs, the Lead Agency should consult the District's Toxics Evaluation Section to review information gathered pursuant to the AB 2588 Program. AB 2588 requires plants emitting TACs to prepare inventories of TAC emissions from the facility. The District has prioritized these facilities based on the quantity and toxicity of the emissions, and their proximity to areas where the public may be exposed. Facilities put in a "high priority" category were required to prepare a comprehensive, facility-wide health risk assessment. The Lead Agency should review the health risk assessments for facilities subject to AB 2588 on file at the District offices. For facilities for which risk assessments have been conducted, these assessments may be used to identify an area around the facility within which individuals would be exposed to cancer or noncancer risks that would be identified as significant impacts. For facilities for which risk assessments have not been conducted, the District's Toxics Evaluation Section should be consulted to determine whether location of nearby sensitive receptors would expose individuals to cancer or noncancer risks that would be considered significant.

3.7 Evaluating Impacts of Accidental Releases of Hazardous Materials

Health and safety impacts associated with accidental releases of acutely hazardous materials (AHMs) should be evaluated when: 1) a facility storing or using AHMs is proposed near an existing residential area or other sensitive receptor, and 2) a proposed project would result in new receptors locating near an existing facility storing or using AHMs. As noted in Section 2.3, this evaluation should be based on the analyses conducted pursuant to the Risk Management Prevention Program (RMPP) process. Lead Agencies should consult with the local administering agency of the RMPP process (usually the county health department) for guidance in evaluating impacts from accidental releases.

3.8 Evaluating Cumulative Impacts

The evaluation of a project's cumulative impacts should be based on an analysis of the consistency of the project with the local general plan and the local general plan with the regional air quality plan. Refer to the discussion in Section 2.3 of these Guidelines regarding Cumulative Impacts and Plan Impacts for guidance on evaluating cumulative impacts.

3.9 Evaluating Plans

Planning documents such as city and county general plans, specific area plans and redevelopment plans should be evaluated for their potential air quality impacts. The evaluation of a plan's air quality impacts should focus on an analysis of the plan's consistency with the most recently adopted regional air quality plan. At the time of this writing, the most recently adopted regional air quality plan is the *Bay Area 1994 Clean Air Plan* (CAP). (As the CAP is updated in future years, the analysis should evaluate consistency with the updated CAP.)

To evaluate local plan consistency with the CAP, the Lead Agency should consider the following: the local plan's consistency with CAP population and vehicle use projections, the extent to which the plan implements CAP transportation control measures, and whether the plan

provides buffer zones around sources of odors and toxics. Refer to Section 2.3, Thresholds of Significance, for guidance on how to determine whether a local plan is consistent with the CAP.

In most cases, quantification of future air pollutant emissions is not necessary as part of this analysis. If a Lead Agency does quantify emissions, note that the URBEMIS5 model discussed previously should not be used to analyze plan impacts. Other models, such as DTIM or BURDEN, may be more appropriate. There may be some instances where quantification of a plan's air quality impacts is appropriate. For example, a specific plan or a redevelopment plan might lead to increased traffic congestion (and possibly cause high CO concentrations) or result in substantial growth in stationary sources of air pollutants. Lead Agencies should consider including a quantitative assessment of a plan's impacts if warranted by special circumstances.

CHAPTER 4 - MITIGATING AIR QUALITY IMPACTS

4.1 Introduction

CEQA requires Lead Agencies to eliminate or minimize significant environmental impacts associated with projects subject to their (discretionary) approval. If an environmental document indicates that a proposed project will have any significant environmental impacts, the document should identify feasible mitigation measures to reduce the impacts below a level of significance. If, after the identification of all feasible mitigation measures, a project is still deemed to have significant environmental impacts, the Lead Agency must adopt a Statement of Overriding Considerations to explain why further mitigation measures are not feasible and why approval of a project with significant unavoidable impacts is warranted.

The District considers a project's air quality impacts to be reduced below a level of significance if the impacts are mitigated to levels below the thresholds discussed in Chapter 2 of these Guidelines. CEQA documents should identify all significant air quality impacts that may result from a project, propose mitigation measures to reduce those impacts, and evaluate the effectiveness of the mitigation measures. To the extent feasible, the effectiveness of mitigation measures should be quantified. The analysis of mitigation measures' effectiveness should be based on reasonable assumptions, and the analysis and underlying assumptions should be clearly explained. The estimation of the effectiveness of mitigation measures is discussed further below.

This chapter provides guidance on mitigation measures that may be implemented to reduce air quality impacts from project construction and operations. The chapter also provides guidance regarding evaluating mitigation measure effectiveness, addresses mitigation monitoring and reporting requirements, and identifies other useful resources and guidance documents. The lists of mitigation measures included in this chapter are not considered to be exhaustive, and Lead Agencies and project proponents are encouraged to think creatively in devising measures to mitigate air quality impacts.

4.2 Mitigating Construction Impacts

Although the impacts from construction related air pollutant emissions are temporary in duration, such emissions can still represent a significant air quality impact. In some cases, construction impacts may represent the largest air quality impact associated with a proposed project. Construction activities such as grading, excavation and travel on unpaved surfaces can generate substantial amounts of dust, and can lead to elevated concentrations of PM_{10}. Emissions from construction equipment engines also can contribute to high localized concentrations of PM_{10}, as well as increased emissions of ozone precursors and carbon monoxide.

Control measures for construction emissions of PM_{10} are discussed in Section 2.3, Thresholds of Significance. Table 2 describes a variety of measures to mitigate construction-related emissions of PM_{10}. Some control measures, e.g., watering the site twice daily and sweeping roadways, should be implemented at all construction sites, regardless of size. Additional measures are recommended for larger sites (over four acres) where emissions will usually be greater.

As noted previously in these Guidelines, the District does not expect Lead Agencies to provide detailed quantification of construction emissions. Similarly, Lead Agencies need not quantify emission reductions from construction-related mitigation measures. The District's recommended approach to mitigating construction emissions focuses on a consideration of whether all feasible control measures are being implemented. (See Section 2.3 for further information.) If a Lead Agency chooses to quantify the effect of construction-related mitigation measures, the Lead Agency should consult Section 13.2.3, Heavy Construction Operations, and related sections of the most recent edition of U.S. EPA's Compilation of Air Pollutant Emission Factors, Volume I: Stationary, Point and Area Sources, AP-42. (When quantifying the effectiveness of construction mitigation measures, the estimated effectiveness of each mitigation measure should be applied only to the corresponding source of emissions. For example, paving or sweeping access roads will reduce emissions of entrained dust from travel on the roadways, but will not reduce emissions from grading and earth moving.)

The discussion of construction impacts and mitigation measures in these Guidelines focuses primarily on PM_{10} emissions from fugitive dust sources. Lead Agencies seeking to reduce emissions from construction equipment exhaust should consider the following mitigation measures:

- Use alternative fueled construction equipment.
- Minimize idling time (e.g., 5 minute maximum).
- Maintain properly tuned equipment.
- Limit the hours of operation of heavy duty equipment and/or the amount of equipment in use.

4.3 Mitigating Air Quality Impacts Through Land Use and Design Measures

There is a growing recognition among air quality professionals that the location, intensity, configuration and design of land use development greatly influences travel behavior and air quality. Land use patterns typical of post-World War II development have contributed greatly to increases in motor vehicle use and emissions. Characteristics that contribute to automobile dependency include low residential and commercial densities, segregated land uses, and street and site design guided solely by the needs of the automobile. Air quality and transportation planners are concluding that we must reexamine the way we build our communities in order to reduce reliance on the automobile. There are myriad ways in which land use influences travel behavior. Examples of such considerations include the following:

- Are residential and commercial developments of sufficient density to support transit service?

- Are neighborhoods sufficiently "compact" to encourage walking and biking for errands, socializing, etc.?

- Are houses, jobs and services located close enough together to allow walking and biking for at least some trips?

- Does the circulation network and the design of individual streets provide a safe and attractive environment for bicyclists and pedestrians?

- Do the designs of individual development projects provide direct, safe and attractive pedestrian access to transit stops and nearby development?

- Does the community have a rough balance between the number of jobs and the number of employed residents?

Solutions do not necessarily have to occur on a grand scale. Incremental improvements can be made by actions as simple as including a neighborhood commercial center within a residential development, locating a child care center near a transit station, placing parking in the rear of a commercial building, or providing sidewalks and benches in new subdivisions or commercial development. The District strongly encourages Lead Agencies and project proponents to take advantage of every opportunity to make development projects more pedestrian-, bicycle- and transit-friendly.

In recent years, increased attention is also being paid to more ambitious solutions, such as "Transit-Oriented Development". Transit-Oriented Development (TOD) is a land use strategy which is intended to reduce the automobile dependence of typical suburban growth. TOD designs specifically emphasize the needs of pedestrians and transit users. TOD designs include features such as clustering of public and commercial uses around a "town center", a range of residential densities, narrower street widths, and a gridded street pattern. TODs can be defined as follows:

> (TODs) are mixed-use neighborhoods, up to 160 acres in size, which are developed around a transit stop and core commercial area. The entire TOD site must be within an average 2,000 foot walking distance of a transit stop. Secondary areas of lower density housing, schools, parks, and commercial and employment uses surround TODs for up to one mile.[18]

TODs may come in various shapes and sizes, depending on the surrounding built environment. "Urban TODs" are oriented toward rail stations and express bus stops, and are characterized by a greater proportion of employment-generating land uses and higher commercial and residential densities. "Neighborhood TODs" are more appropriate for high frequency bus routes and feeder routes, and place greater emphasis on housing and local-serving shopping and services.

Improved coordination of land use and transportation planning and greater emphasis on making communities more transit-, bicycle- and pedestrian-friendly can reduce reliance on the automobile for all kinds of trips: trips to work, shopping, school, recreation, personal business. Such strategies can result in many other benefits to the community as well, such as reduced

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[18] Calthorpe Associates, "Transit-Oriented Development Design Guidelines," prepared for the City of San Diego, 1992.

traffic congestion, energy conservation, preservation of open space, improved water quality (fewer contaminants in urban run-off), and more attractive, cohesive communities.

Land use considerations also can reduce air quality problems not related to motor vehicle use. By separating residential areas and other sensitive receptors from sources of odors, dust and toxic air contaminants, health and nuisance impacts can be minimized. Buffer zones should *always* be provided between sensitive receptors and sources of odors, dust, toxics and accidental releases of hazardous materials. (As noted in Section 2.1, Early Consultation, some infill and mixed use projects occasionally may result in sensitive receptors and sources of odors or toxics being in close proximity. Lead Agencies are encouraged to promote infill and mixed use development, but should avoid locations that would lead to health or nuisance impacts to sensitive receptors.)

Many land use and design measures can be implemented on a project-by-project level. For instance, the site plan for a commercial development can promote pedestrian access by locating parking lots in the rear of the building and placing building entrances near transit stops and sidewalks. Or the circulation plan for a residential subdivision can provide dedicated bicycle routes and direct pedestrian access to transit stops and adjacent development. (As noted in Section 2.1, Early Consultation, land use and design measures targeted at individual projects should be addressed as early in the development review process as possible so as to minimize costs to developers and local government and increase the likelihood of implementation.)

Many land use and design measures, however, are most effective if implemented community-wide, or even at the subregional level. Issues such as allowable land use densities, mixing of land uses, street standards, parking requirements, etc. are most appropriately addressed throughout the entire community or subregion. Policy documents such as general plans and specific area plans, as well as implementing mechanisms such as zoning ordinances, parking standards and design guidelines, may need to be revised. Ad hoc implementation of these strategies to individual projects can still be beneficial, even absent a community-wide strategy, but the benefits will be greater if implemented broadly. For example, a 1993 study by U.C. Berkeley researchers examined the effects of (rail) transit-based development on transit ridership.[19] The study found that residents of higher density housing located near rail transit stations commuted by rail at much higher rates than did residents living further away from transit stations. The study concluded, however, that the increases in transit ridership were much more pronounced if the worksite also was located near a transit station and if the worksite charged for parking. In other words, concentrating housing near transit helps, but the location and parking policies of the destinations are also critical factors.

Therefore, the District strongly encourages local governments to examine local plans and implementing programs to look for opportunities to better coordinate land use, transportation and air quality planning. To the extent that cities and counties can make their communities more transit-, bicycle- and pedestrian-friendly, and minimize land use conflicts that lead to toxics and nuisance problems, the need to mitigate significant air quality impacts of individual development

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[19] Cervero, Robert, "Ridership Impacts of Transit-Focused Development in California", for the National Transit Access Center, November 1993.

proposals will be minimized. The District and ABAG have jointly prepared a guidance document to assist local governments in developing these strategies, *Improving Air Quality Through Local Plans and Programs, A Guidebook for City and County Governments*. Copies are available from ABAG. Appendix F of these Guidelines lists additional resources that may be useful.

A study released by the ARB in June 1995 may be especially useful to Lead Agencies considering land use strategies to reduce air pollutant emissions. The report, prepared by JHK & Associates, is titled *Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emissions: An Indirect Source Research Study*. The report discusses a number of land use strategies that can reduce motor vehicle use and emissions:

- Provide pedestrian facilities.
- Increase density near transit corridors.
- Increase density near transit stations.
- Encourage mixed-use development.
- Encourage infill and densification.
- Develop concentrated activity centers.
- Strengthen downtowns.
- Develop interconnected street network.
- Provide strategic parking facilities.

The report provides estimates of the measures' effectiveness in reducing vehicle use and emissions in various types of communities (urban, suburban and exurban). The estimated ranges of effectiveness are based on quantitative data from existing California communities. It is hoped that by identifying ranges of effectiveness for the land use measures, local officials will be able to set performance goals (e.g., vehicle trips or emissions per household) for their communities. The report recommends combinations of strategies to achieve the performance goals, and provides guidance on implementation mechanisms. One of the study's findings is that although it is difficult to quantify reductions in vehicle use and emissions from individual strategies applied at individual sites, combinations of strategies implemented community-wide can achieve significant reductions in vehicle use and emissions. The report is available from ARB's Transportation Strategies Group.

4.4 Mitigating Impacts of Project Operations

Introduction

In many cases, motor vehicles traveling to and from a facility represent the principal source of air pollutants associated with the project. Therefore, this section focuses primarily on measures to reduce mobile source emissions by reducing motor vehicle trips and vehicle miles traveled. If the procedures outlined in Chapters 2 and 3 of these Guidelines indicate that a project's motor vehicle emissions would be a significant impact, mitigation measures should be identified to reduce the impact to a level of insignificance.

A wide variety of measures may be implemented to reduce air pollutant emissions resulting from land use development. The appropriateness of a given mitigation measure depends on a number of factors, such as the type and size of project being proposed, the location and characteristics of the community in which the project will be located, neighboring land uses, availability of transit, etc. For example, consider the provision of bicycle racks and showers and lockers at a worksite in order to encourage commuters to bike to work. Such measures will be more effective in a community with a comprehensive network of bicycle routes and fairly flat terrain than in a community with poor bicycle access and hilly terrain. Lead Agencies and project proponents should carefully consider the specific nature of the project and its setting when developing mitigation measures.

Estimating the Effectiveness of Mitigation Measures for Project Operations

To the extent feasible, the effectiveness of proposed mitigation measures should be quantified. Because the measures' effectiveness will depend greatly on the specific characteristics of the project and its setting, this quantification should be based on a project-specific analysis whenever possible. For mitigation measures to reduce vehicle use, this means conducting a travel analysis for the project using appropriate local modeling inputs.

Tables 15 and 16 identify mitigation measures that may be used to reduce motor vehicle emissions from commercial and residential projects, respectively. The tables provide estimates of each measure's effectiveness in reducing vehicle trips. In cases where a range of estimated effectiveness is provided, the low end of the range should be used unless local conditions warrant a higher figure. The column of supporting factors should be consulted to see if a higher figure is justified. The effectiveness estimates are based on a review of published literature and represent what the District believes to be reasonable expectations regarding effectiveness. However, the percentages in Tables 15 and 16 are default values, and should be used only in the absence of project-specific analysis.

Several cautionary notes regarding estimating the effectiveness of mitigation measures are warranted.

Clearly explain the assumptions underlying the environmental document's analysis of mitigation measures' effectiveness. The analysis should specifically describe the mitigation measure, identify the source(s) of air pollutants that are expected to be affected by the measure, clearly explain how and to what extent the measure will affect the source(s), and identify the basis for the estimate (empirical observations, computer modeling, case studies, etc.). Critical assumptions should be linked to the mitigation monitoring and reporting program. For example, if the environmental analysis for a commercial development assumes that 20% of employees will carpool to work, then such an objective should be included in the mitigation monitoring and reporting program as a test of whether the measure is being implemented.

Be specific regarding implementation of mitigation measures. The environmental document should describe each mitigation measure in detail, identify who is responsible

for implementing the measure, and clearly explain how and when the measure will be implemented. Methods for assessing the measure's effectiveness once it is in place, and possible triggers for additional mitigation if necessary, are also desirable. This level of detail regarding mitigation measure implementation frequently is not addressed until the preparation of the mitigation monitoring and reporting program, which often takes place very late in the environmental review process. In order to reliably assess the effectiveness and feasibility of mitigation measures, however, the District believes it is necessary to consider the specifics of mitigation measure implementation as early in the environmental review process as possible.

Be sure not to double count the effect of proposed mitigation measures. The project description and assumptions underlying the analysis of project impacts should be carefully considered when estimating the effect of mitigation measures. If certain conditions or behavior are assumed in the impact analysis, then credit may not be claimed when proposing mitigation measures. For example, if the traffic and air quality analyses for a proposed project assume that a certain percentage of people will access the project by transit or bicycle, then any credit claimed for transit- or bicycle-related mitigation must clearly demonstrate effectiveness above and beyond the mode split assumed in the impact analysis.

In some cases it simply may not be possible to quantify the effect of proposed mitigation measures. It may be that the specific conditions surrounding a particular project are so unique as to render extrapolation from other examples unreliable. A proposed measure may be innovative, with little precedent. The combined effects of a package of measures may be too difficult to quantify. While a certain degree of professional judgment is usually involved in estimating the effectiveness of mitigation measures, overly speculative estimates should be avoided. If the Lead Agency cannot quantify mitigation effectiveness with a reasonable degree of certainty, the environmental document should at least address effectiveness qualitatively. If the Lead Agency makes a finding that non-quantified mitigation measures reduce an impact to a level of insignificance, the document should provide a detailed justification of that conclusion.

Mitigating Impacts from Motor Vehicles

Several general approaches can be taken to reduce emissions from motor vehicles:

- Reduce vehicle trips. These measures reduce air pollutant emissions by eliminating entirely some of the vehicle trips associated with a project. An example would be the provision of bicycle facilities to encourage bicycle use instead of driving.

- Reduce vehicle miles traveled. These measures reduce emissions by reducing the length of vehicle trips associated with a project. An example would be the provision of satellite offices/telecommuting centers to reduce the distance of employee commute trips.

- Use of low emission vehicles. These measures do not aim to reduce trips or VMT, but rather promote the use of fuels that are less polluting than gasoline or diesel. An example would be the conversion of a vehicle fleet to operate on compressed natural gas.

- Improve traffic flows/reduce congestion. These measures reduce emissions by reducing traffic congestion and/or reducing stops and starts. This allows vehicles to operate at steady and moderate speeds, and thus lowers pollution per mile traveled. An example would be timing the traffic signals on an arterial to facilitate uninterrupted travel.

- Support measures. These measures may not directly reduce emissions, but rather support and facilitate other emission reduction strategies. An example would be a guaranteed ride home program implemented at a worksite in order to encourage employees to use commute alternatives by allaying concerns over being without a vehicle in case of emergency.

Emission reduction measures from each of the above categories can be implemented in combination with one another. (Support measures, by definition, are implemented to reinforce other emission reduction strategies.) In general, the District prefers measures that reduce vehicle trips entirely, as they achieve the greatest emission reductions. (This is because vehicle emissions are highest during the first several miles of a trip.) Strategies to reduce VMT should also be pursued, however. Reducing VMT has a greater impact on PM_{10} emission than other pollutants, because PM_{10} emission (due to entrained road dust) are more directly correlated to VMT. Measures to encourage low emission vehicles are also desirable, especially for projects that include a sizable fleet of vehicles (delivery services, taxis, airport shuttles, airport ground support equipment, etc.). Traffic flow improvements may be beneficial if congestion is a major factor in the air quality impact, but particular caution is warranted to avoid traffic-inducing effects of increased roadway capacity.

4.5 Mitigating Odor Impacts

Projects that have a significant odor impact because they place sources of odors and members of the public near each other should establish a buffer zone to reduce odor impacts to a less than significant level. The dimensions of the buffer zone must ensure that the encroaching project does not expose the public to nuisance levels of odorous emissions. In establishing the appropriate dimensions of the buffer zone, the Lead Agency should consider actions currently being taken at the facility to control odors, as well as any future actions to which the facility is firmly committed. A safety margin also should be considered in establishing a buffer zone to allow for future expansion of operations at the source of the odors.

In order to reduce the dimensions of the buffer zone, add-on control devices (e.g., filters or incinerators) and/or process modifications implemented at the source of the odors may be feasible, depending on the specific nature of the facility. Lead Agencies should consult the District's Enforcement Division for further information regarding add-on controls and process modifications to control odors. Odor mitigation measures that are targeted at the *receptors* (e.g., residential areas) that rely on sealing buildings, filtering air or disclosure statements are not appropriate mitigation measures to be used in lieu of buffer zones or technical controls.

TABLE 15
MITIGATION MEASURES FOR REDUCING MOTOR VEHICLE EMISSIONS FROM COMMERCIAL, INSTITUTIONAL AND INDUSTRIAL PROJECTS

Mitigation Measure	Supporting Factors to Enhance Effectiveness	Effectiveness
Rideshare Measures		
Implement carpool/vanpool program e.g., carpool ridematching for employees, assistance with vanpool formation, provision of vanpool vehicles, etc.	• Employer provides support measures such as carpool/vanpool subsidies, preferential parking, guaranteed ride home program, etc. • Coordinate with regional ridesharing organization, e.g., RIDES for Bay Area Commuters. • Multiple smaller worksites coordinate programs. • Limited parking supply and/or implementation of parking fees or parking cash-out.	1% - 4% (work trips)
Transit Measures		
Construct transit facilities such as bus turnouts/bus bulbs, benches, shelters, etc.	• Transit service with frequent headways available at project or on roadways adjacent to project. • Transit use incentives for employees, e.g., on-site distribution of passes, subsidized transit passes, etc. • Transit route maps and schedules posted at stops. • Shade trees/landscaping planted at transit stops.	0.5% - 2% (all trips)
Design and locate buildings to facilitate transit access, e.g., locate building entrances near transit stops, eliminate building setbacks, etc.	• Jurisdiction provides design guidelines addressing transit accessibility. • Consultation with transit provider during project design, review.	0.1% - 0.5% (all trips)
Services Measures		
Provide on-site shops and services for employees, such as cafeteria, bank/ATM, dry cleaners, convenience market, etc.	• Sufficient number of employees at worksite, or cooperation among multiple worksites. • Safe, direct pedestrian access between employment and retail areas. • Jurisdiction provides density bonuses, other incentives to encourage mixed land uses.	0.5% - 5% (work trips)

Provide on-site child care, or contribute to off-site child care within walking distance.	• Sufficient number of employees at worksite, or cooperation among multiple worksites.	0.1% - 1% (work trips)
Shuttle Measures		
Establish mid-day shuttle service from worksite to food service establishments/commercial areas.	• Sufficient number of employees at worksite, or cooperation among multiple worksites. • Commercial area located within 3 miles. • Frequent, scheduled service during lunch hours. • Coordination among multiple employers, e.g., at business parks. • Provide commute shuttle to transit station, use same vehicle for mid-day shuttle.	0.5% - 1.5% (work trips)
Provide shuttle service to transit stations/multimodal centers.	• Major transit facility/multimodal center located within 3 miles of project. • Transit use incentives for employees, e.g., on-site distribution of passes, subsidized transit passes, etc. • Frequent, scheduled service during peak commute periods. • Coordination among multiple employers, e.g., at business parks. • Free or subsidized service. • Provide mid-day shuttle to commercial areas, use same vehicle for commute shuttle.	1% - 2% (work trips)
Parking Measures		
Provide preferential parking (e.g., near building entrance, sheltered area, etc.) for carpool and vanpool vehicles.	• Most effective if parking supply is limited and/or located far from building entrance.	0.5% - 1.5% (work trips)
Implement parking fees for single occupancy vehicle commuters.	• Reduced or waived fees for carpools and vanpools. • Complemented by transit, ridesharing programs, other commute alternatives. • Revenues used to support commute alternatives. • Provisions in place to avoid offsite parking spillover.	2% - 20% (work trips)

Implement parking cash-out program for employees (i.e., non-driving employees receive transportation allowance equivalent to value of subsidized parking).	• Complemented by transit, ridesharing programs, other commute alternatives. • Implement at worksites not subject to State parking cash-out requirements. • Tax benefits if travel allowance offered as transit/ridesharing subsidy. • Provisions in place to avoid offsite parking spillover.	2% - 20% (work trips)
Bicycle and Pedestrian Measures		
Provide secure, weather-protected bicycle parking for employees.	• Bicycle parking location is more convenient than auto parking. • Project located adjacent to, or within 1/4 mile of, Class I bicycle path or Class II bicycle lane. • Significant number of employees live within 5 miles of worksite. • Employer provides bicycle support measures, e.g., bicycle route maps, tools for emergency repairs, etc.	0.5% - 2% (work trips)
Provide safe, direct access for bicyclists to adjacent bicycle routes.	• Local jurisdiction has adopted comprehensive bicycle plan. • Significant number of employees live within 5 miles of worksite. • Employer provides bicycle support measures, e.g., bicycle route maps, tools for emergency repairs, etc. • Provide push buttons or sensors to activate traffic signals.	0.5% - 2% (work trips)

Provide showers and lockers for employees bicycling or walking to work.	• Significant number of employees live within 5 miles (bicycling)/2 miles (walking). • Project located adjacent to, or within 1/4 mile of, Class I bicycle path or Class II bicycle lane. • Employer provides bicycle support measures, e.g., bicycle route maps, tools for emergency repairs, etc.	0.5% - 2% (work trips)
Provide secure short-term bicycle parking for retail customers and other non-commute trips.	• Bicycle parking location is more convenient than auto parking. • Project located adjacent to, or within 1/4 mile of, Class I bicycle path or Class II bicycle route.	1% - 2% (non-work trips)
Provide direct, safe, attractive pedestrian access from project to transit stops and adjacent development.	• Jurisdiction provides design guidelines addressing pedestrian accessibility. • Pedestrians separated from traffic, parking areas. • Shade trees/landscaping planted at pedestrian areas. • Benches, fountains, other amenities provided to enhance pedestrian environment.	0.5% - 1.5% (all trips)
Other Measures		
Implement compressed work week schedule (e.g., 4/40, 9/80).	• Consult with employees prior to program implementation.	2% - 10% (work trips)
Implement home-based telecommuting program.	• Participation increased if employer provides/assists with provision of equipment (modem, computer, etc.). • Especially effective if employee commute trips are long.	0.5% - 1.5% (work trips)

TABLE 16
MITIGATION MEASURES FOR REDUCING MOTOR VEHICLE EMISSIONS FROM RESIDENTIAL PROJECTS

Mitigation Measure	Supporting Factors to Enhance Effectiveness	Effectiveness
Provide neighborhood-serving shops and services within or adjacent to (1/4-1/2 mile) residential project.	• Direct pedestrian/bicycle access is available. • Medium or high residential densities located closer to commercial areas. • Jurisdiction has design guidelines addressing issues such as pedestrian access, parking, compatibility with neighboring land uses, etc.	1% - 4% (all trips)
Provide transit facilities, e.g., bus bulbs/turnouts, benches, shelters, etc.	• Transit service is available in or adjacent to project. • Project is of sufficient density to support transit service. • Transit service with frequent headways. • Consultation with transit provider during project design, review	0.2% - 2% (all trips)
Provide shuttle service to regional transit system or multimodal center.	• Transit station or multimodal center located within 5 miles of project. • Medium to high residential densities.	0.1% - 0.5% (all trips)
Provide shuttle service to major destinations such as employment centers, shopping centers, schools.	• Destinations located within 5 miles of project. • Medium to high residential densities.	0.1% - 0.3% (all trips)
Provide bicycle lanes and/or paths, connected to community-wide network.	• Local jurisdiction has adopted comprehensive bicycle plan. • Project is located adjacent to, or within 1/4 mile of, Class I bicycle path or Class II bicycle lane. • Routes are direct and convenient, not curving recreational paths.	0.1% - 2% (all trips)

Provide sidewalks and/or paths, connected to adjacent land uses, transit stops, and/or community-wide network.	• Destinations such as commercial areas, schools, parks, community centers, etc. are located nearby. • Cul-de-sacs are discouraged, or easements are provided for pedestrian access. • Shade trees/landscaping provided.	0.1% - 1% (all trips)
Provide satellite telecommute centers in large residential developments.	• Most effective if residential area is located far from employment centers	0.1% - 1.5% (work trips)
Provide interconnected street network, with a regular grid or similar interconnected street pattern.	• Multiple ingress/egress points are available. • Large, multi-lane arterials are discouraged. • Reduced street widths and curb radii. • Cul-de-sacs are discouraged. • Street trees required.	1% - 5% (all trips)

4.6 Mitigating Impacts from Toxic Air Contaminants and Accidental Releases of Hazardous Materials

A project would have a significant impact if it resulted in members of the public being close enough to either 1) a source of toxic air contaminants (TACs) or 2) a potential source of accidental releases of hazardous materials, such that the thresholds described in Section 2.3 would be exceeded. To mitigate such impacts, a buffer zone should be provided between the source and the receptors. The appropriate dimensions of the buffer zone will depend on a variety of factors, including the nature of the activities occurring at the source, the types and quantities of materials being stored or used at the facility, and local topography and meteorology.

As discussed in Section 2.3, the determination of significant impact with respect to accidental releases should be based on analyses prepared pursuant to the Risk Management Prevention Program (RMPP). RMPP analyses will be key inputs in establishing the appropriate dimensions of buffer zones around potential sources of accidental releases. Lead Agencies should consult with the local administering agency of the RMPP process (usually the county health department) when establishing buffer zones around sources of accidental releases to assure that the thresholds described in Section 2.3 are not exceeded.

The determination of significance with respect to TAC emissions will generally be based on analyses conducted as part of the District's permitting process and/or implementation of the Air Toxics "Hot Spots" (AB 2588) program. Section 3.6 describes processes for evaluating potential TAC impacts. These analyses will assist Lead Agencies in establishing buffer zones and, if necessary, identifying other mitigation measures to reduce TAC impacts.

In most cases, control devices and/or changes in industrial processes may be implemented at the source(s) in order to reduce the risk from TAC emissions or accidental releases. All feasible measures to reduce risks from TAC emissions and accidental releases should be implemented. While such measures may reduce the necessary dimensions of a buffer zone, they do not obviate the need to maintain buffer zones to protect public health and safety. This is particularly true in situations where residential development (or any other sensitive receptor) is encroaching on an existing source of TACs or accidental releases. Also, as noted above regarding odor impacts, mitigation measures for TACs or accidental releases (such as disclosure statements, sealing of buildings, community alert procedures, etc.) that are targeted at potential *receptors* are not appropriate mitigations to be used in lieu of buffer zones or technical controls.

4.7 Mitigation Monitoring and Reporting

State law requires that when a public agency makes findings based on an EIR that mitigation measures are required to avoid or lessen significant environmental effects identified in the EIR, the public agency must adopt a reporting or monitoring program for those mitigation

measures (California Public Resources Code, Section 21086.6). This requirement is intended to assure that mitigation measures included in a certified EIR are indeed implemented. A mitigation monitoring and reporting program should include the following components:

- A description of each mitigation measure adopted by the Lead Agency.
- The party responsible for implementing each mitigation measure.
- A schedule for the implementation of each mitigation measure.
- The agency or entity responsible for monitoring mitigation measure implementation.
- Criteria for assessing whether each measure has been implemented.
- Enforcement mechanism(s).

Although the mitigation monitoring and reporting program is not required to be included in the EIR, the District recommends that the Lead Agency do so. This will encourage the Lead Agency and other entities to specifically consider the feasibility and effectiveness of each mitigation measure while the environmental analysis is still underway.

If a responsible agency or any agency having jurisdiction over natural resources affected by the project proposes mitigation measures, the Lead Agency may require that agency to prepare a monitoring and reporting program for those mitigation measures.

APPENDIX A - AIR QUALITY LAWS, PROGRAMS AND STANDARDS

This appendix summarizes the major federal and State laws, regulations and programs that establish the legal framework for protecting and improving air quality in the Bay Area. Some of these regulations have air quality improvement as their primary purpose. Others deal with air quality within the context of other public objectives. Table A-1 summarizes national and State ambient air quality standards — the quantitative air quality objectives that the Bay Area is required to attain.

FEDERAL PROGRAMS

Federal Clean Air Act and 1990 Clean Air Act Amendments. National ambient air quality standards (NAAQS) were established in 1970 by the federal Clean Air Act for six pollutants: carbon monoxide, ozone, particulate, nitrogen dioxide, sulfur dioxide and lead. These pollutants are commonly referred to as "criteria" pollutants because they are considered the most prevalent air pollutants that are known to be hazardous to human health and because criteria documents, including ambient air quality standards, have been prepared for each of these contaminants.

The Act required states exceeding the NAAQS to prepare air quality plans showing how the standards were to be met by December 1987. The Act was amended in 1977, and again in 1990, to extend the deadline for compliance and require that revised State Implementation Plans (SIP) be prepared. Failure to submit and implement an acceptable plan meant a state could be denied federal highway funding and/or be required to increase emission offsets for industrial expansion. The 1990 Clean Air Act Amendments established categories of air pollution severity for nonattainment areas ("marginal" to "extreme"). SIP requirements varied, depending on degree of severity. (For a discussion of the Bay Area's portion of the California SIP, see "Bay Area Regional Agencies and their Programs" below.)

The conformity provisions of the Act are essentially designed to ensure that federal agencies contribute to, instead of jeopardizing, efforts to achieve the NAAQS. In November of 1993, U.S. EPA issued two regulations implementing these provisions. The transportation conformity regulation deals with transportation projects. The general conformity regulation addresses actions of federal agencies other than the Federal Highway Administration and the Federal Transit Administration.

The primary requirements of transportation conformity of note to Lead Agencies are that transportation plans and programs cannot produce more emissions than were budgeted for in the latest SIP. Projects receiving federal funds or approvals also must undergo localized air quality modeling. Finally, emissions from local projects with no federal funding must be included in regional plans and programs, if the sponsoring agency receives any federal funds.

TABLE A-1 AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards[1] Concentration	National Standards[2] Concentration[3]
Ozone	1 Hour	0.09 ppm	0.12 ppm
Carbon Monoxide	8 Hour	9.0 ppm	9 ppm
	1 Hour	20 ppm	35 ppm
Nitrogen Dioxide	Annual Average		0.053 ppm
	1 Hour	0.25 ppm	
Sulfur Dioxide	Annual Average		80 µg/m^3
	24 Hour	0.04 ppm	365 µg/m^3
	1 Hour	0.25 ppm	
Suspended Particulate Matter (PM_{10})	Annual Arithmetic Mean		50 µg/m^3
	Annual Geometric Mean	30 µg/m^3	
	24 Hour	50 µg/m^3	150 µg/m^3
Sulfates	24 Hour	25 µg/m^3	
Lead	Calendar Quarter		1.5 µg/m^3
	30 Day Average	1.5 µg/m^3	
Hydrogen Sulfide	1 Hour	0.03 ppm	
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm	
Visibility Reducing Particles[4]	8 Hour (10 am to 6 pm PST)	10-mile visual range when relative humidity is less than 70%	

ppm = parts per million. µg/m^3 = micrograms per cubic meter.

FOOTNOTES

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, suspended particulate matter - PM_{10}, and visibility reducing particles are values that are not to be exceeded. The standards for sulfates, lead, hydrogen sulfide, and vinyl chloride are not to be equaled or exceeded. If the standard is for a 1-hour, 8-hour or 24-hour average (i.e., all standards except for lead and the PM_{10} annual standard), then some measurements may be excluded. In particular, measurements are excluded that ARB determines would occur less than once per year on the average.

2. National standards other than for ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The ozone standard is attained if, during the most recent three-year period, the average number of days per year with maximum hourly concentrations above the standard is equal to or less than one.

3. National air quality standards are set at levels determined, by the U.S. Environmental Protection Agency, to be protective of public health with an adequate margin of safety. As the table indicates, the State of California has set more stringent standards for a number of contaminants, based on independent medical judgment.

4. This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range when relative humidity is less than 70 percent.

General conformity applies to a wide range of actions or approvals by federal agencies. Potentially covered by the regulation are actions of concern to local governments such as decisions on wastewater treatment facilities and airport expansions. Essentially, projects are subject to general conformity if they generate more emissions than minimum thresholds set in the rule (currently 100 tons per year of ROG, NO_x, or CO in the Bay Area), and that are not specifically exempted by the regulation. Such projects are required to fully offset or mitigate the emissions caused by the action. This includes both direct emissions and indirect emissions over which the federal agency has some control.

The U.S. EPA also has programs for identifying and regulating toxic air pollutants (air toxics). The Clean Air Act Amendments of 1990 directed EPA to set standards for air toxics and to require facilities to sharply reduce emissions of controlled chemicals. The 1990 Amendments specified 174 industrial sources that are to be regulated. An industry is classified as a major source — and must be regulated — if it emits ten tons per year of any of the listed air toxics, or a combination of 25 tons or more of all listed air toxics.

National Environmental Policy Act (NEPA). NEPA requires that major projects to be conducted or approved by the federal government be subject to environmental assessments. If the potential for significant adverse environmental impacts exists, an Environmental Impact Statement (EIS) must be prepared and circulated to affected jurisdictions and the interested public.

Intermodal Surface Transportation Efficiency Act, 1991 (ISTEA). This law requires a regional transportation planning process that includes consideration of 15 factors, two of which address consistency with adopted land use plans and potential environmental effects. ISTEA also provides funds for transportation projects and activities that contribute to meeting air quality standards, including transit, pedestrian, and bicycle-oriented projects. The Congestion Management and Air Quality Improvement Program (CMAQ) directs funds toward transportation projects that will contribute to the attainment of NAAQS for ozone and carbon monoxide. The funds are distributed based on population size and severity of a region's air pollution problem.

CALIFORNIA PROGRAMS

California Clean Air Act, 1988. The 1988 California Clean Air Act (CCAA), amended in 1992, requires regions to develop and implement strategies to attain California's ambient air quality standards. For some pollutants, the California standards are more stringent than the national standards. In addition to the six criteria pollutants regulated by the federal Clean Air Act, California has established standards for three other pollutants: hydrogen sulfide, sulfates, and vinyl chloride. In general, the CCAA requires regions like the Bay Area, which exceed certain State air quality standards for criteria pollutants, to reduce emissions of harmful pollutants by five percent or more per year or implement all feasible measures to meet the state air quality standards as expeditiously as possible. Regional air quality management districts like the BAAQMD must prepare air quality plans specifying how State standards

would be met. State agencies are required to implement a number of statewide automobile emission control regulations, including the "Smog Check" program.

State Motor Vehicle Emission Control Program. The California Air Resources Board (ARB) regulates the amount of pollutants that can be emitted by new motor vehicles sold in California. California motor vehicle emission standards are more stringent than the federal standards and have become increasingly more stringent since they were first imposed in 1961 by the State Motor Vehicle Pollution Control Board (the predecessor to the ARB). To help meet the State ambient air quality standards, the ARB has instituted regulations that will require manufacturers selling vehicles in California to manufacture and phase-in a proportion of motor vehicles in the following categories: Transitional Low Emission Vehicles, Low Emission Vehicles, Ultra-Low Emission Vehicles, and Zero Emission Vehicles (e.g., electric vehicles — 10% of California-sold vehicles by 2003). These requirements apply to passenger vehicles and are intended to reduce emissions of carbon monoxide, reactive hydrocarbons, and nitrogen oxides. The ARB has also set requirements for the distribution of alternative fuels.

ARB also has implemented a heavy duty vehicle inspection program, which applies to diesel-powered trucks and buses. The ARB is also working on fuel requirements that would reduce toxic emissions from motor vehicles. The California Bureau of Automotive Repair continues to administer the vehicle inspection and maintenance program (I/M or "Smog Check" Program).

Air Toxics "Hot Spots" Information and Assessment Act, 1987. The Air Toxic "Hot Spots" Information and Assessment Act was enacted by the California Legislature to identify toxic air contaminant hot spots where emissions from specific sources may expose individuals to elevated risk of adverse health effects. The State Department of Health Services and the Air Resources Board work together to administer the provisions of this Act statewide, but its implementation and enforcement are the responsibility of local/regional air districts. The Act requires that a business or other establishment, identified as a significant source of toxic emissions, notify the affected population and provide them with information about health risks posed by the emissions. (While not part of the Hot Spots program, the State of California Health and Safety Code, Section 25534 allows "Administering Agencies" — usually county health departments — to require "Risk Management and Prevention Plans" of facilities which handle hazardous materials.) Appendix E provides further information on the Air Toxics "Hot Spots" program.

California Planning Law and Guidelines. The State of California does not require air quality elements for general plans. Seven elements are mandated by the California Government Code. Air quality is mentioned as an optional issue in the "Conservation" element. Nonetheless, the District has been urging all cities and counties in the Bay Area to include an air quality element or section in their general plans since 1986.

One of the most important features of California general plans is that even though air quality elements are not mandated, general plans are required by law to be consistent with any air quality policies and programs that exist within local jurisdiction. Local plans must also be consistent with regional air quality plans such as the Bay Area Clean Air Plan.

California Transportation Plan. The most recent State transportation plan prepared by Caltrans addresses air quality, and cites the funding of transportation control measures (TCMs) as a high priority. In addition, telecommuting is promoted as well as other "nonstructural" transportation solutions such as: reducing demand, increasing transit service, and implementing market-based measures (e.g., a demonstration project of congestion pricing on the San Francisco-Oakland Bay Bridge).

BAY AREA REGIONAL AGENCIES AND THEIR PROGRAMS

Bay Area Air Quality Plan, 1979 and 1982. The *Bay Area Air Quality Plan* is a regional plan required by the federal government. It is prepared jointly by the District, the Metropolitan Transportation Commission (MTC), and the Association of Bay Area Governments (ABAG) to address how the Bay Area will attain the NAAQS. The plan contains stationary source controls, motor vehicle emission controls, and transportation system improvement measures that would reduce the amount of air pollutants released into the atmosphere. These measures are implemented primarily by the District, ARB and MTC, respectively.

The federal Clean Air Act (1970, 1977) required the District, MTC and ABAG to prepare the first Bay Area Air Quality Plan in 1979 and then amend it in 1982. Its primary objective was to attain NAAQS by 1987. The 1982 Air Quality Plan required that: (1) major stationary sources install emission control devices, (2) new sources apply for air quality permits, (3) registered Bay Area vehicles pass a vehicle inspection and maintenance program (e.g., "Smog Check") every two years, (4) transportation control measures be implemented, and (5) MTC assess the conformity of regional transportation plans, programs and projects to air quality objectives.

Although these requirements resulted in significant air quality improvement, the Bay Area failed to attain NAAQS for carbon monoxide and ozone by 1987. In 1989, in response to a court order, MTC implemented contingency measures to assure that the Bay Area was making all reasonable further progress toward attaining NAAQS. These measures included additional transportation control measures and a revised conformity assessment procedure.

Ozone Maintenance Plan, 1993. Under the 1990 federal Clean Air Act Amendments, the Bay Area was classified as "moderate" for ozone. The federal air quality plan requirements include: (1) new procedures for assessing conformity of plans, programs and projects with air quality objectives; (2) a plan designating how volatile organic compounds will be reduced by 15 percent by 1996 (15% Plan); and (3) a plan to achieve the national ozone standard by 1996 (Attainment Plan).

Through 1989, the Bay Area air basin had continued to violate the national ozone standard. As a result, the Bay Area carried a formal designation of "non-attainment" for the national ozone standard. But because of significant improvements in Bay Area air quality over the last couple of decades, the number of exceedances of the national ozone standard declined greatly. Air quality monitoring data from 1990 to 1994 indicated that the region had attained the national ozone standard. Based on monitoring data collected from 1990 to 1992, the District, MTC and ABAG requested in 1993 that the U.S. EPA redesignate the Bay Area as an attainment area. In June, 1995 U.S. EPA approved the request and the Bay Area was redesignated an attainment area with respect to the national ozone standard. Because the region is no longer a nonattainment area, the 15% Plan and Attainment Plan requirements are no longer applicable.

Under the federal Clean Air Act, regions that have attained air quality standards still must demonstrate how they will maintain compliance with the standard in future years. The redesignation request submitted to U.S. EPA, the "San Francisco Bay Area Redesignation Request and Maintenance Plan for the National Ozone Standard" (Maintenance Plan), demonstrated that the region had attained the national ozone standard *and* outlined how the Bay Area would maintain the standard in the future. The Maintenance Plan included air monitoring data, a demonstration of continuing attainment for at least ten years, contingency measures in case maintenance of the standard is at risk, as well as certain administrative requirements.

The Maintenance Plan does not include any new control strategies or control measures. The Plan states that the national ozone standard has already been met and indicates that, with control measures already in place, ozone levels can be expected to continue decreasing. The Maintenance Plan also includes an improved Inspection and Maintenance Program as a contingency measure in the event that the current strategies do not maintain the standard, as well as certain stationary source control measures.

Carbon Monoxide Maintenance Plan, 1994. From 1992 through 1994, no District monitor has registered an exceedance of the national carbon monoxide standard. Therefore, a *San Francisco Bay Area Redesignation Request and Maintenance Plan for the National Carbon Monoxide Standard* was adopted in 1994 by the three regional agencies. In April 1996, ARB is expected to adopt a CO Redesignation Request and Maintenance Plan for most of California, including the Bay Area.

Bay Area Clean Air Plan, 1994. The *Bay Area 1994 Clean Air Plan* (CAP) was prepared pursuant to the 1988 California Clean Air Act. Prepared by the District in cooperation with MTC and ABAG, its main objective is to attain the State air quality standards for ozone. The CAP presents a comprehensive strategy to reduce emissions from stationary, area and mobile sources. The CAP includes a specific measure which encourages cities and counties to develop and implement local plans, policies and programs to reduce auto use and improve air quality. The California Clean Air Act requires regions to update their (State) air quality plans every three years. The CAP will be updated in 1997.

Under the California Clean Air Act nonattainment classifications, the Bay Area is classified as a "serious" air basin for ozone. (The state classification system for nonattainment areas uses the designations "Moderate," "Serious," "Severe," and "Extreme.") The region had been classified a "moderate" air basin for CO, but the region was redesignated an attainment area for the State CO standard in 1994 and thus the Act's planning requirements for CO nonattainment areas no longer apply to the Bay Area. The CAP must indicate how the District will attain the State ozone standard by the earliest practicable date, including: (1) additional control measures for existing stationary sources, (2) a permitting program that will result in no net increase in emissions from new stationary sources, (3) provisions for indirect source controls, and (4) transportation control measures.

The prime objective of transportation control measures (TCMs) is to reduce vehicle trips and vehicle miles traveled within the region. These measures are geared toward the following: (1) trip reduction, (2) mobility improvements, (3) implementation support, (4) traffic operation management, (5) user incentives, and (6) pricing strategies.

The CAP also strives to reduce emissions by implementing additional and more stringent stationary source control measures. These include measures to control emissions from surface coating and solvent use, fuels/organic liquids storage and distribution, refinery and chemical processes, combustion of fuels, and other industrial/commercial processes.

The California Clean Air Act expanded the scope and accelerated the pace of air pollution control efforts in California. If possible, air quality plans should achieve a reduction in district-wide emissions of 5% per year for each nonattainment pollutant or its precursors. As an alternative strategy (employed in the Bay Area CAP), the adoption of all feasible measures on an expeditious schedule is acceptable, even if a district is unable to achieve 5% annual reduction.

Other legal requirements applicable to the Bay Area include the following:

- Indirect source and area source control programs.
- A regional public education program.
- Transportation controls to achieve a 1.4 average vehicle ridership during weekday commute hours by 1999, substantial reduction in the rate of increase of vehicle trips and vehicle miles traveled and no net increase in motor vehicle emissions after 1997.
- An assessment of cost-effectiveness of proposed control measures.
- Transport mitigation requirements.

Toxic Air Contaminant Control Program. The Toxic Air Contaminant Control Program is a regional program administered by the District. Its main objective is to reduce public

exposure to toxic air contaminants. Appendix E provides further information on the District's Air Toxics program.

Odorous Substances Regulation. The District has enacted an odorous substance control program as part of its effort to control the use and emission of odorous substances within the Bay Area. This program places general limitations on odorous substances and provides the District with authority to respond to public complaints about offensive odors. The regulation is intended to help the public identify and control offensive odors that are not otherwise controlled by other federal or State air quality laws.

Regional Transportation Plan, 1994. The Metropolitan Transportation Commission's Regional Transportation Plan (RTP) guides Bay Area transportation system improvement projects and shows how they will help attain regional air quality objectives. The plan promotes projects that will provide reasonable and predictable mobility within the region, ensure that all people have equitable access to transportation, support a healthy environment and mitigate any adverse impacts, and promote economic vitality within the region. The plan identifies and evaluates the Bay Area Metropolitan Transportation System, a network of regionally significant streets and highways, transit systems and intermodal transfer facilities, and recommends projects that will improve its performance. Many of these recommendations implement federal (1982 Bay Area Air Quality Plan and contingencies) and state ('94 CAP) TCMs.

Congestion Management Program. Each county in the state is required to establish a Congestion Management Agency (CMA) and prepare a Congestion Management Program (CMP). The main goals of the CMP are to establish a political process through which countywide roadway congestion can be controlled or relieved, and to develop a comprehensive strategy to respond to countywide transportation needs. State law requires that each CMA prepare, implement and biennially update the CMP. The CMP consists of the following basic elements: (1) a transportation network that includes State highways and principal arterials, (2) traffic level of service (LOS) standards for the CMP network, (3) performance measures to evaluate current and future multimodal system performance for the movement of people and goods, (4) a travel demand program to promote travel by alternative transportation modes (non-single-occupancy vehicle), (5) a land use impact analysis program to evaluate land use development impacts on the CMP network, and (6) a multi-year capital improvement program (CIP) to fund transportation projects that support CMP goals. The CMP must be updated biennially to reflect changing transportation needs and conditions within the county. The CMP CIP must be submitted to MTC every two years to be incorporated into the Bay Area Regional Transportation Improvement Program.

If traffic conditions on a roadway segment or intersection fall below the LOS standard, the local jurisdiction is required to develop a Deficiency Plan. In some instances, cities and counties may be monitoring LOS based upon transportation models, attempting to predict conditions in the future. The intent is to develop plans for deficient segments prior to the actual occurrence of a deficiency. The CMP statutes direct the District to establish and

periodically update a list of improvements, programs and actions which can be used by local governments in developing Deficiency Plans. The list should include items that "...measurably improve multimodal performance, and contribute to significant improvements in air quality, such as improved public transit service and facilities, improved non-motorized transportation facilities, high occupancy vehicle facilities, parking cash out programs, and transportation control measures." The statutes also state that "if an improvement, program, or action is not on the approved list, it shall not be implemented unless approved by the local air quality management district." In 1992, the District prepared the *Deficiency List: Programs, Actions and Improvements for Inclusion in Congestion Management Program Deficiency Plans.* Subsequent consultation with Bay Area CMAs has not indicated a need to revise the deficiency list.

Transportation Fund for Clean Air (AB 434). Assembly Bill 434 (Sher, 1991) established a vehicle registration surcharge to fund specified TCMs. This bill gave the District the authority to impose a $4 surcharge on motor vehicle registrations within the Bay Area to pay for programs that reduce mobile source emissions. These fees generate approximately $17 million per year. The District directly allocates 40 percent of the funds to county program managers who then distribute the funds to agencies sponsoring eligible projects. The District allocates the remaining 60 percent regionwide to public agencies sponsoring the most cost-effective projects.

The projects and programs eligible for AB 434 funds are: (1) ridesharing and trip reduction programs, (2) clean fuel buses for schools and transit operators; (3) feeder bus/shuttle service to rail and ferry stations and airports; (4) local arterial traffic management; (5) rail-bus integration and regional transit information; (6) congestion pricing and low emission vehicle demonstration projects; (7) vehicle buy back; (8) a smoking vehicle program (citizen reports to the District about vehicles with visible exhaust); and (9) bicycle facility improvements.

APPENDIX B - AIR POLLUTANT SOURCES AND EFFECTS

This appendix discusses the harmful effects of air contaminants on health and other qualities of life and the environment. Sources of air pollution are described. Appendix C provides more detailed information on air pollutant emissions in the Bay Area.

CRITERIA CONTAMINANTS — HEALTH EFFECTS AND SOURCES

Criteria contaminants are those air pollutants for which ambient air quality standards have been set by the United States Environmental Protection Agency or the California Air Resources Board. Most of the criteria contaminants are generated to a large degree by motor vehicles, as well as by industry and other stationary sources. Appendix C provides further detail regarding the sources of each criteria contaminant in each county of the Bay Area.

Carbon Monoxide (CO) is an odorless, colorless gas. It is formed by the incomplete combustion of fuels. The single largest source of CO is the motor vehicle. Emissions are highest during cold starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. New findings indicate that CO emissions per mile are lowest at about 45 mph for the average light-duty motor vehicle and begin to increase again at higher speeds.

When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease or anemia, as well as fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death.

Ozone (O_3), or smog, is not emitted directly into the environment, but is formed in the atmosphere by complex chemical reactions between oxides of nitrogen and reactive organic gases (ROG) in the presence of sunlight. Ozone formation is greatest on warm, windless, sunny days. The main sources of nitrogen oxides (NO_X) and ROG, often referred to as ozone precursors, are combustion processes (including motor vehicle engines) and the evaporation of solvents, paints and fuels. As with CO, automobiles are the single largest source of ozone precursors in the Bay Area. Tailpipe emissions of ROG follow CO. They are highest during cold starts, hard acceleration, stop-and-go conditions, and slow speeds. They decline as speeds increase up to about 50 mph, then increase again at high speeds and high engine loads. ROG emissions associated with evaporation of unburned fuel depends on vehicle and ambient temperature cycles. Nitrogen oxide emissions exhibit a different curve; emissions decrease as the vehicle approaches 30 mph and then begin to increase with increasing speeds.

Ozone levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis and emphysema. Chronic exposure to high ozone levels can permanently damage lung

tissue. Ozone can also damage plants and trees, and materials such as rubber and fabrics (see Non-Health Effects, below).

Nitrogen dioxide (NO_2) is a reddish brown gas that is a by-product of combustion processes. Automobiles and industrial operations are the main sources of NO_2. Aside from its contribution to ozone formation, nitrogen dioxide can increase the risk of acute and chronic respiratory disease and reduce visibility. NO_2 may be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high ozone levels.

Sulfur dioxide (SO_2) is a colorless acid gas with a strong odor. It has potential to damage materials and it can have health effects at high concentrations. It is produced by the combustion of sulfur-containing fuels, such as oil, coal and diesel. Sulfur dioxide can irritate lung tissue and increase the risk of acute and chronic respiratory disease.

PM_{10} (Particulate matter 10 microns or less in diameter) refers to a wide range of solid or liquid particles in the atmosphere, including smoke, dust, aerosols, and metallic oxides. Some particulate matter, such as pollen, is naturally occurring. However, in the Bay Area most particulate matter is caused by combustion, factories, construction, grading, demolition, agricultural activities and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. PM_{10} is of concern because it bypasses the body's natural filtration system more easily than larger particles, and can lodge deep in the lungs. Thus, the U.S. EPA and the state of California revised their PM standards several years ago to apply only to these fine particles.

As with CO and ozone precursors, motor vehicles constitute the single largest source of PM_{10} in the Bay Area, based on the best available data. Motor vehicles produce particulates through direct tailpipe emissions of particulate matter; direct emissions of nitrogen oxides, which become particulate ammonium nitrate in the atmosphere; and the kicking up of road dust by tires. Vehicles also produce PM_{10} from brake pad and tirewear. Motor vehicles are currently responsible for about half of Bay Area particulates.

Fine particulate pollution is an example of a problem that is projected to increase in the Bay Area as motor vehicle use increases, though there may be short-term decreases. For instance, when construction activity is reduced during a recession, direct construction dust is reduced. Therefore there is less dirt spilled on roads via trucks and other mobile equipment, reducing the amount of dust that can be resuspended by the tires of passing motor vehicles. But, as seen in the graph of Bay Area Emissions Inventory Projections (in Appendix C), total PM_{10} emissions are expected to increase, and the proportion attributable to motor vehicles will also increase. Resuspended road dust has not been reduced by improvements in motor vehicle air pollution controls. In fact, road dust is expected to continue to increase unless there is a reduction in motor vehicle use and adoption of dust control measures. Dust control measures may be needed at construction sites, unpaved roads and parking lots, agricultural and other area sources that emit dust directly into the ambient air and/or convey mud and dirt to roadways.

Wood burning in fireplaces and stoves is another large source of fine particulates. The District and consultants have recently analyzed the results of a study of the sources of particulates at two monitoring sites in San Jose. In and near downtown San Jose — and perhaps in many other parts of the Bay Area — wood smoke can contribute up to 40% of the particulate mix during the winter months. Wood burning alone may cause exceedances of California's particulate standard.[20]

Among the criteria pollutants that the District regulates, particulates appear to represent the most serious overall health hazard. Studies in a number of cities have demonstrated statistically significant correlations between daily and average annual particulate levels and mortality. According to one estimate, elevated particulate levels contribute to the death of approximately 200 people annually for the Bay Area.[21] Other studies, which include findings from the Bay Area, yield higher estimates of mortality — 300 to 500 deaths per year in the Bay Area — based on a one percent increase in mortality per 10 micrograms per cubic meter increase in PM_{10} levels.[22][23] High levels of particulates have also been known to exacerbate chronic respiratory ailments, such as bronchitis and asthma, and have been associated with increased emergency room visits and hospital admissions.

TOXIC AIR CONTAMINANTS

In addition to the *criteria pollutants* listed above, another group of pollutants, commonly referred to as toxic air contaminants (TACs) or hazardous air pollutants, has received increasing scrutiny in recent years and warrant concern for several reasons. First, the health effects can be quite severe. Many hazardous air pollutants are confirmed or suspected carcinogens, or are known or suspected to cause birth defects or neurological damage. Secondly, many hazardous air pollutants can be toxic at very low concentrations. For some chemicals, such as carcinogens, there are no thresholds below which exposure can be considered risk-free.

Industrial facilities are significant sources of toxic air contaminants. Rather than coming out of a smokestack, however, toxic contaminants often result from "fugitive emissions," such as leaking valves and pipes. The electronics industry, including semiconductor manufacturing, has the potential to contaminate both air and water due to the highly toxic chlorinated solvents commonly used in semiconductor production processes. Sources of air toxics go beyond industry, however. Various common urban facilities also produce hazardous pollutants, such as gasoline stations (benzene), hospitals (ethylene oxide), and dry cleaners

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[20] Chow, Judith, and David Fairley et al., "Source Apportionment of Wintertime PM_{10} at San Jose, California," Journal of Environmental Engineering, May 1995.

[21] Fairley, David, "The Relationship of Daily Mortality to Suspended Particulates in Santa Clara County, 1980-1986," Environmental Health Perspectives, Vol. 89, 1990.

[22] Ostro, Bart, "The Association of Air Pollution and Mortality: Examining the Case for Inference," Archives of Environmental Health, September/October 1993.

[23] Dockery, Douglas and C.A. Pope III, "Acute Respiratory Effects of Particlate Air Pollution," Annual Review of Public Health, 1994.

(perchloroethylene). Automobile exhaust also contains toxic air pollutants such as benzene and 1,3-butadiene. (Lead as a gasoline additive has been phased out in California). District research indicates that mobile source emissions of benzene and 1,3-butadiene represent a substantial portion of the ambient background risk from toxic air contaminants in the Bay Area. Reformulated fuel requirements that have already been adopted are expected to reduce, but not eliminate, mobile source TAC emissions.

NON-HEALTH EFFECTS OF AIR POLLUTION

Visibility Reduction

Visibility reduction and discoloration of the sky are obvious effects of air pollution. Reduced visibility may be caused by the brownish haze of nitrogen dioxide or by the accumulation of particulate matter in the atmosphere. When particles are present in sufficient quantities, distant objects become obscured. Visibility reduction is primarily caused by emissions from the following sources:

- Construction and demolition.
- Auto exhaust, diesel soot, and resuspended road dust.
- Wood burning, incineration, and other combustion activities.
- Particles or aerosols formed by photochemical reactions occurring in the atmosphere.
- Agricultural and mining activities.
- Stationary sources such as cement kilns and refineries.
- Naturally occurring particles from salt water, vegetation, soil, and wind erosion processes.
- Atmospheric particles, normally too small to affect visibility, which grow to visibility-reducing size through the process of agglomeration (clustering) or through condensation, where moisture condenses on small particles causing them to grow to visibility-reducing size.

Visibility in the Bay Area can vary dramatically, depending on meteorological conditions. The major factors causing these fluctuations are the amount of moisture in the air, the strength of the air currents, and the volume of air available for dilution and dispersion of visibility-reducing particles. Under adverse weather conditions, particularly high heat and intense sunlight, some or all of the factors discussed above cause visibility to become very restricted. These conditions are especially common in summer and early fall.

During the winter months, visibility-reducing particles from photochemical activity are greatly diminished due to colder temperatures and the decreased intensity of ultraviolet light. Thus, when restricted visibility occurs during this period, it is often caused by smoke and dust particles and the growth of particles through agglomeration and condensation.

Effects on Materials

Air pollution effects on materials vary widely in type and severity among the different contaminants. For example, ozone, the primary constituent of photochemical smog, can harden and crack rubber materials, causing them to lose their flexibility. It also affects other types of synthetic materials. For example, it can weaken nylon, and can cause fabric dye fading and paint damage.

Other pollutants in combination produce synergistic effects, causing greater damage than each could cause alone. The interaction of sulfur dioxide and particulate matter has a greatly enhanced ability to corrode materials such as steel, iron, copper, zinc, tin, and stone. In some industries, extensive measures must be taken to protect equipment from polluted air. In the aerospace industry, for example, where silver and other metals used in sensitive electronic equipment are particularly vulnerable to corrosion, great care must be taken to protect components.

Particles settling on buildings, automobiles, outdoor furniture, and other surfaces are usually considered to be nuisances causing soiling, even when they do not produce damage to health or materials.

Plant Damage

The effects of air pollution on plants, crops, and forests depend both on plant susceptibility and the types of pollutants involved. Plant damage is difficult to assess because damage is often manifested as stunted growth or diminished yields, rather than the death of the plant.

Among the recorded effects of air pollution on plants are flower and foliage discoloration; bloom failure; plant malformation; leaf, needle, and fruit drop; and failure of fruit to ripen. Particularly vulnerable to ozone damage are grapes, lettuce, spinach and many garden flowers and shrubs. Additionally, some greenhouse crops, including flowers and some herbs, suffer damage when certain hydrocarbon levels are elevated.

Localized plant damage has been noted in the Bay Area from other gases, including nitric oxide, hydrogen chloride, formaldehyde, sulfur dioxide, and fluorides. Sulfur dioxide, for example, is particularly damaging to pasture crops and leafy vegetables. And although a highly localized problem, fluoride threatens both plants and animals. The susceptibility of plants to fluoride damage varies greatly; apricots, grapes, strawberries, bulb crops, and conifers have low resistance. The more serious effect is seen in animals, who may consume fodder that offers no detectable signs of damage but in fact contains relatively high concentrations of fluorides. Over a period of time, animals build up a concentration of fluorides in their tissues, which eventually leads to fluorosis, a bone disease.

APPENDIX C - AIR POLLUTION — STATUS, PROBLEMS AND TRENDS

Monitoring Data and Attainment Status

The District operates a regional air quality monitoring network that regularly measures the concentrations of the five major criteria air pollutants. Figure C-1 indicates the location of the District's permanent monitoring stations and lists the pollutants monitored at each station. Tables C-1, C-2, C-3 and C-4 summarize the exceedance records for the last decade for ozone, CO and PM_{10}.

In terms of air quality, the San Francisco Bay Area could generally be considered one of the cleanest major metropolitan area in the United States. With U.S. EPA's June 1995 redesignation of the region as an attainment area for the national ozone standard, the Bay Area became the largest metropolitan area in the U.S. to have achieved the ozone standard. Though there were a number of new exceedances during the hot days of summer in 1995, the region should retain and reestablish its clean air record in the future. Table C-1 summarizes recent monitoring data with respect to the national ozone standard.

The Bay Area continues to violate the State ozone standard, however. The State one-hour ozone standard, 9 parts per hundred million (9 pphm), is considerably more stringent than the national standard of 12 pphm. Table C-2 indicates the number of days the State ozone standard has been exceeded in recent years.

The region has made significant progress in reducing carbon monoxide levels in the Bay Area. The District's air monitoring records of 1992 through 1994 demonstrate attainment of the national and State eight-hour standard (9 parts per million, or ppm, in both cases), and neither the national one-hour standard (35 ppm) nor the State one-hour standard (20 ppm) has been exceeded since the 1980s. The Bay Area is now an attainment area for the State CO standard, and has submitted a Redesignation Request for the national CO standard. Table C-3 summarizes recent monitoring data for the State and national CO standard.

With regard to fine particulate matter (PM_{10}), the State standard has been exceeded fairly frequently in recent years. The national standard was exceeded a few times in 1990 and 1991, but has not been exceeded since then. Table C-4 summarizes recent monitoring data for the State and national PM_{10} standards.

Additional criteria pollutants include nitrogen dioxide, sulfur dioxide, sulfates, lead, hydrogen sulfide, and vinyl chloride (chloroethane). Neither State nor national ambient air quality standards of these chemicals have been violated in recent decades. Table 1 (in Chapter 1 of these Guidelines) summarizes the Bay Area's attainment status for the State and national ambient air quality standards.

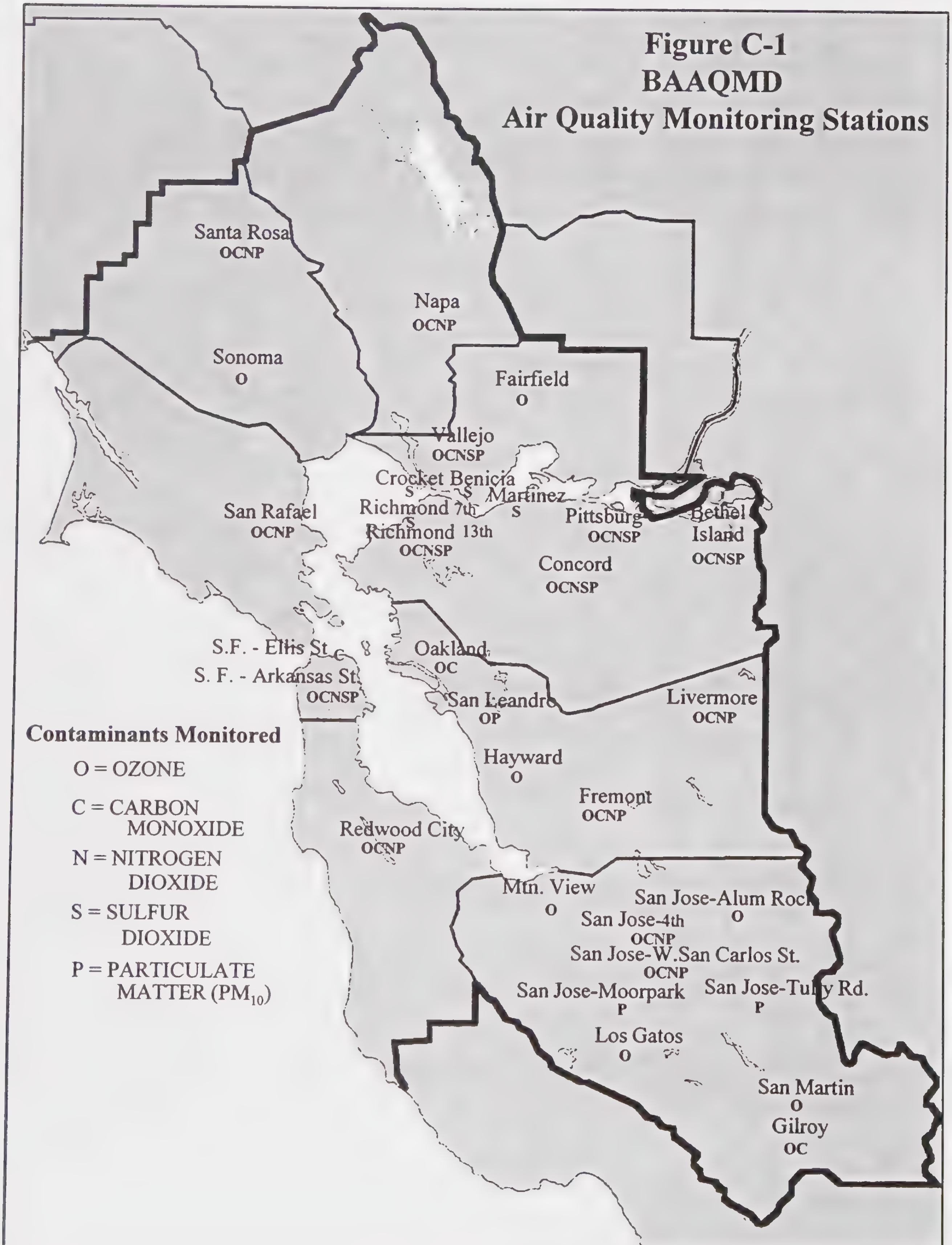
Figure C-1
BAAQMD
Air Quality Monitoring Stations
Santa Rosa
OCNP
Napa
OCNP
Sonoma
O
Fairfield
O
Vallejo
OCNSP
Crocket Benicia
S S
Martinez
S
Richmond 7th
S
Richmond 13th
OCNSP
San Rafael
OCNP
Pittsburg
OCNSP
Bethel
Island
OCNSP
Concord
OCNSP
S.F. - Ellis St
C
S. F. - Arkansas St.
OCNSP
Oakland
OC
San Leandro
OP
Livermore
OCNP
Contaminants Monitored
O = OZONE
C = CARBON MONOXIDE
N = NITROGEN DIOXIDE
S = SULFUR DIOXIDE
P = PARTICULATE MATTER (PM10)
Hayward
O
Fremont
OCNP
Redwood City
OCNP
Mtn. View
O
San Jose-Alum Rock
O
San Jose-4th
OCNP
San Jose-W.San Carlos St.
OCNP
San Jose-Moorpark
P
San Jose-Tully Rd.
P
Los Gatos
O
San Martin
O
Gilroy
OC

TABLE C-1
EXCEEDANCES OF THE NATIONAL OZONE STANDARD

Number Of Days With Maximum One-Hour Concentration Exceeding 12 Parts Per Hundred Million (pphm)

1985 - 1995

County	Site	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Alameda County	Fremont	4	2	4	1	0	1	0	0	1	0	2
	Hayward	1	0	1	0	0	0	0	1	0	0	2
	Livermore	4	3	3	4	2	1	1	0	1	2	7
	Oakland	0	0	0	0	0	0	0	0	0	0	0
	San Leandro	0	0	0	0	0	0	0	0	0	0	3
Contra Costa County	Concord	1	0	3	1	0	0	0	0	2	0	3
	Pittsburg	1	0	2	0	0	0	0	0	1	0	0
	Richmond	0	0	0	0	0	0	0	0	0	0	0
	Bethel Island	2	0	0	0	0	0	0	0	0	0	1
Marin County	San Rafael	0	0	0	0	0	0	0	0	0	0	0
Napa County	Napa	0	0	0	0	0	0	0	0	0	0	1
San Francisco	San Francisco	0	0	0	0	0	0	0	0	0	0	0
San Mateo County	Redwood City	1	0	0	0	0	0	0	0	0	0	1
Santa Clara County	Mountain View	0	1	4	0	0	0	0	0	0	0	0
	San Martin	-	-	-	-	-	-	-	-	-	1	1
	Gilroy	2	0	4	1	2	0	1	0	0	0	1
	Los Gatos	4	0	4	1	0	0	0	1	1	0	4
	San Jose-4th Street	2	1	1	0	1	0	0	0	0	0	1
	San Carlos St./ Burbank	-	-	-	-	-	1	0	0	1	0	-
	Alum Rock	2	1	6	0	0	0	0	1	0	0	3
Solano County	Fairfield	0	0	0	1	0	0	0	0	1	0	1
	Vallejo	0	0	0	0	0	0	0	0	0	0	1
Sonoma County	Santa Rosa	0	0	0	0	0	0	0	0	0	0	0
	Sonoma	0	0	0	0	0	0	0	0	0	0	0
AIR DISTRICT DAYS		22	5	14	5	4	2	2	2	3	2	11

"*AIR DISTRICT DAYS*" are the number of days in a year that one or more monitoring stations recorded an exceedance. Air District Days are not usually the sums of the numbers above them in the column because two or more monitoring stations often record exceedances during the same day. More than three exceedances in three years, at any one monitoring station, rates a federal classification of "nonattainment" for ozone for the entire air basin.

- = Monitor not operational.

TABLE C-2
EXCEEDANCES OF THE STATE OZONE STANDARD

Number Of Days With Maximum One-Hour Concentration Exceeding 9 Parts Per Hundred Million (pphm)

1985-1995

County	Site	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Alameda County	Fremont	8	3	17	7	11	3	6	5	5	4	10
	Hayward	5	1	12	9	1	0	2	1	0	1	7
	Livermore	21	20	10	21	9	8	17	14	7	5	20
	Oakland	0	0	1	1	0	0	0	0	1	0	0
	San Leandro	0	0	0	0	0	0	2	2	3	0	6
Contra Costa County	Concord	10	5	20	10	6	3	4	3	7	4	9
	Pittsburg	3	1	14	8	5	4	0	3	4	3	8
	Richmond	0	0	0	2	1	0	0	0	2	0	0
	Bethel Island	8	8	14	7	11	5	3	7	3	5	6
Marin County	San Rafael	0	0	1	1	0	0	0	0	0	0	0
Napa County	Napa	3	0	6	1	2	0	3	0	2	0	4
San Francisco	San Francisco	0	0	0	0	0	0	0	0	0	0	0
San Mateo County	Redwood City	5	1	2	2	1	0	0	0	1	0	5
Santa Clara County	Mountain View	2	1	16	13	6	1	3	1	2	0	2
	San Martin	-	-	-	-	-	-	-	-	-	5	14
	Gilroy	18	5	19	23	10	5	5	12	6	3	10
	Los Gatos	20	21	25	12	1	5	7	3	8	2	13
	San Jose-4th St.	12	12	23	12	10	4	6	3	3	2	14
	San Carlos St./ Burbank	-	-	-	-	-	5	0	1	4	1	-
	Alum Rock	16	5	22	13	9	1		5	5	3	15
Solano County	Fairfield	4	0	9	3	4	1	3	3	3	2	10
	Vallejo	5	0	6	5	2	2	2	1	3	2	6
Sonoma County	Santa Rosa	0	0	1	0	0	0	0	0	0	0	1
	Sonoma	3	1	2	2	3	0	3	0	0	0	0
AIR DISTRICT DAYS		45	39	45	41	22	14	23	23	19	13	28

"AIR DISTRICT DAYS" are the number of days in a year that one or more monitoring stations recorded an exceedance. Air District Days are not usually the sums of the numbers above them in the column because two or more monitoring stations often record exceedances during the same day.

- = Monitor not operational.

TABLE C-3
EXCEEDANCES OF NATIONAL AND STATE* CARBON MONOXIDE STANDARD
Number Of Days With Maximum 8-Hour Concentration Exceeding 9 Parts Per Million (ppm)

1985-1995

County	Site	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Alameda County	**Fremont**	0	0	0	0	0	0	0	0	0	0	0
	Livermore	0	0	0	0	0	0	0	0	0	0	0
	Oakland	0	0	0	0	0	0	0	0	0	0	0
Contra Costa County	**Concord**	0	0	0	0	0	0	0	0	0	0	0
	Pittsburg	0	0	0	0	0	0	0	0	0	0	0
	Richmond	0	0	0	0	0	0	0	0	0	0	0
	Bethel Island	0	0	0	0	0	0	0	0	0	0	0
Marin County	**San Rafael**	0	0	0	0	0	0	0	0	0	0	0
Napa County	**Napa**	0	0	0	0	0	0	0	0	0	0	0
San Francisco	**Arkansas St./ Potrero**	0	0	0	0	0	0	0	0	0	0	0
	Ellis Street	2 (3)	2	1	1	0	0	0	0	0	0	0
San Mateo County	**Redwood City**	0	0	0	0	0	0	0	0	0	0	0
Santa Clara County	**Gilroy**	0	0	0	0	0	0	0	0	0	0	0
	San Jose-4th St.	16	4	0	2 (3)	6	2 (5)	4	0	0	0	0
	San Carlos St./ Burbank	-	-	-	-	-	0	0	0	0	0	-
Solano County	**Vallejo**	0	4	0	1	2	0	0 (1)	0	0	0	0
Sonoma County	**Santa Rosa**	0	0	0	0	0	0	0	0	0	0	0
AIR DISTRICT DAYS		16(17)	7	1	3 (4)	8	2 (5)	4 (5)	0	0	0	0

*The recorded number of exceedances of the State — as differentiated from the National — Carbon Monoxide 8-Hour Ambient Air Quality Standard is sometimes slightly higher due to prescribed procedures for calculating each. The State Standard is given as 9.0 ppm and is considered to be exceeded when a monitor records a CO 8-hour average level of 9.1 or higher. The National Standard is given as 9 ppm and is considered to be exceeded at a level of 9.5 ppm or higher. In the table above, when the number of days of exceedance in a year differed among the two, the number of days exceeding the State Standard is given in parentheses.

"AIR DISTRICT DAYS" are the number of days in a year that one or more monitoring stations recorded an exceedance of the ambient air quality standard for CO. Air District Days are not usually the sums of the numbers above them in the column because two or more monitoring stations often record exceedances during the same day. More than one exceedance per year, at any one monitoring station, rates a federal classification of "nonattainment" for CO.

- = Monitor not operational.

TABLE C-4
EXCEEDANCES OF THE STATE AND NATIONAL* FINE PARTICULATE MATTER STANDARD
Number Of Days With Maximum 24-Hour Concentration Exceeding 50 micrograms per cubic meter ($\mu g/m^3$)
1985 - 1995

County	Site	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Alameda County	Fremont	-	-	-	-	5	10	14	4	3	3	1
	Livermore	-	5	5	7	13	10	12 (1)	5	3	4	1
	San Leandro	-	-	-	-	-	-	10	2	1	1	0
Contra Costa County	Concord	-	4	6	10	9	6	13	8	2	4	1
	Richmond	-	-	-	-	5	5	9	3	3	3	1
	Bethel Island	2	3	5	14	7	7	10	4	6	3	3
Marin County	San Rafael	-	4	5	2	8	4	10	5	1	4	1
Napa County	Napa	-	5	8	8	9	8	11	5	3	2	1
San Francisco	San Francisco	-	5	4	7	13	12 (1)	15	9	5	6	0
San Mateo County	Redwood City	-	9	6	5	10	8	12	7	5	6	0
Santa Clara County	San Jose-4th St.	24 (2)	23	22	14	15	9 (1)	10	13	10	7	4
	Moorpark	-	-	-	8	13	11	13	8	3	4	1
	San Carlos St./ Burbank	-	-	-	-	7	9	14	9	5	6	-
	Tully Road	-	-	-	-	-	11 (1)	11	11	7	7	0
Solano County	Vallejo	-	-	-	-	-	-	-	-	-	1	1
Sonoma County	Santa Rosa	-	-	-	-	-	-	-	-	-	1	0
AIR DISTRICT DAYS		24 (2)	26	26	24	21	15 (3)	18 (1)	18	10	9	7

*In instances when the National PM_{10} 24-Hour Standard (150 $\mu g/m^3$) has been exceeded, the number of days of exceedance of the National Standard is given in parentheses.

"AIR DISTRICT DAYS" are the number of days in a year that one or more monitoring stations recorded an exceedance. Air District Days are not usually the sums of the numbers above them in the column because two or more monitoring stations often record exceedances during the same day.

- = Monitor not operational.

Problems and Trends

Throughout the Bay Area, automobile ownership and use is increasing at a faster rate than population growth. Countering this trend is the move toward cleaner, newer vehicles with fleet turnover and the introduction of cleaner fuels. Overall, projections indicate a net reduction in the emissions of ozone precursors and carbon monoxide, while fine particulate emissions are expected to increase with total miles traveled.

Table C-5 shows projected future emissions of criteria pollutants for the Bay Area for the years 1995, 2000, and 2010 in terms of total emissions and motor vehicle emissions. Total emissions and the amount and proportion attributable to motor vehicles decline sharply, especially for reactive hydrocarbons and carbon monoxide. A smaller decline in motor vehicle emissions of nitrogen oxides (NO_x) is predicted, and a small increase is predicted for SO_2 emissions. Most significant is the predicted increase in PM_{10} emissions.

Regionally, the most complex air quality problem has been ozone. Ozone is formed in the atmosphere through a complex series of photochemical reactions involving reactive organic gases (ROG) and NO_x. Motor vehicles account for the majority of the ROG and NO_x emissions. Although the Bay Area's highest ozone levels can fluctuate from year to year depending on weather conditions, ambient ozone standards are exceeded most often in the Santa Clara, Livermore and Diablo valleys.

In contrast to ozone, carbon monoxide (CO) is a more localized concern in the Bay Area, because CO is a nonreactive pollutant with one major source — motor vehicles. Based on the District's emission inventories, approximately 65 percent of CO in the Bay Area is generated by motor vehicles. The areas with the highest CO levels typically have been those with high levels of vehicular traffic. CO levels are strongly influenced by meteorological factors such as wind speed and atmospheric stability. High concentrations of CO build up on cold, clear winter nights with no wind. The eight-hour CO standards historically were occasionally exceeded in those parts of the Bay Area subject to a combination of high traffic density and susceptibility to the occurrence of surface-based radiation inversions, during the winter months. The CO standards were last exceeded prior to 1992 in San Francisco, San Jose and Vallejo.

Air pollution problems related to particulate matter also occur during winter months, usually under the same weather conditions that foster CO buildup. Particulate levels in the Bay Area are typically low near the coast and higher inland, with the highest levels in dry, sheltered valleys, such as the Santa Clara, Livermore and Diablo valleys. The major human-generated (anthropogenic) sources in the Bay Area include motor vehicle travel over paved and unpaved roads, demolition and construction activity and woodburning in fireplaces and stoves. Agricultural operations and burning also contribute significantly to particulate concentrations in rural areas. PM_{10} emissions are expected to increase in future years.

TABLE C-5 MOTOR VEHICLE SHARE OF CRITERIA CONTAMINANT EMISSIONS

Total Emissions and Motor Vehicle Emissions Generated in the Bay Area Air Basin

Tons/Day (Annual Average)

Year	CO	ROG*	NOx	SO_2	PM_{10}**
1995 **Total Emissions**	2425	535	454	102	462
Motor Vehicle (MV) Emissions	1598	242	200	10	321
(MV as % of Total)	(66%)	(45%)	(44%)	(10%)	(70%)
2000 **Total Emissions**	1963	464	441	107	501
Motor Vehicle Emissions	1108	166	171	10	355
(MV as % of Total)	(56%)	(36%)	(39%)	(9%)	(71%)
2010 **Total Emissions**	1600	406	449	115	582
Motor Vehicle Emissions	697	88	161	12	427
(MV as % of Total)	(44%)	(22%)	(36%)	(10%)	(73%)

* Reactive organic gases (anthropogenic — i.e. excluding emissions from natural vegetation)
** Including entrained road dust.

(Projections are based on the Base Year 1990 District Emission Inventory.)

The major sources of nitrogen oxides (NO_X) are vehicular, residential and industrial fuel combustion. Concentrations of nitrogen dioxide, the most abundant form of ambient NO_X, are highest in the South Bay, where the standard was last exceeded in 1980.

Major sources of ambient sulfur dioxide (SO_2) include activities such as electricity generation, petroleum refining and shipping. The highest levels of SO_2 are recorded by monitoring stations located in northern Contra Costa County, where most of the major sources of SO_2 are located. The SO_2 standard is currently being met throughout the Bay Area, with seasonal maximums rarely exceeding 50 percent of the standard. SO_2 levels at most Bay Area monitoring stations are less than 10 percent of the standard.

Emissions Inventory

The District estimates emissions of criteria pollutants from approximately nine hundred source categories. The estimates are based on District permit information for "point sources" (e.g. manufacturing industries, refineries, dry-cleaning plants) plus more generalized estimates for "area sources" (e.g. house heating, use of consumer products) and "mobile sources" (trains, ships and planes, as well as on-road and off-road motor vehicles). Figure C-2 indicates future projections of emissions for the region. The significant role of mobile sources is highlighted in these charts.

Emissions inventories are presented by county in Tables C-6, C-7 and C-8. Tables C-6, C-7 and C-8 indicate projections of emissions, by land use category, for 1995, 2000 and 2010. These projections have been aggregated from the more than 900 categories of emission sources in the District's emission inventory system. More detailed information on individual point sources may be obtained by contacting the District.

The emission inventories and projections assume that the Bay Area will continue to grow as forecast and that all currently adopted control measures will continue. Assumptions underlying the projections include the following:

- Population, housing, employment, economic growth and land use development will increase as regionally forecast (ABAG, *Projections '94*, Dec. 1993).
- New cars will be cleaner than older model vehicles, as required by California regulations.
- The recently improved "Smog Check" program will continue.
- Controls on industry and business will continue.
- Currently implemented transportation control measures will continue.

Lead agencies should be aware that actions which alter these assumptions may also affect progress toward attainment and maintenance of ambient air quality standards.

FIGURE C-2

BAY AREA EMISSION INVENTORY PROJECTIONS 1980-2010

Annual Average Daily Emissions

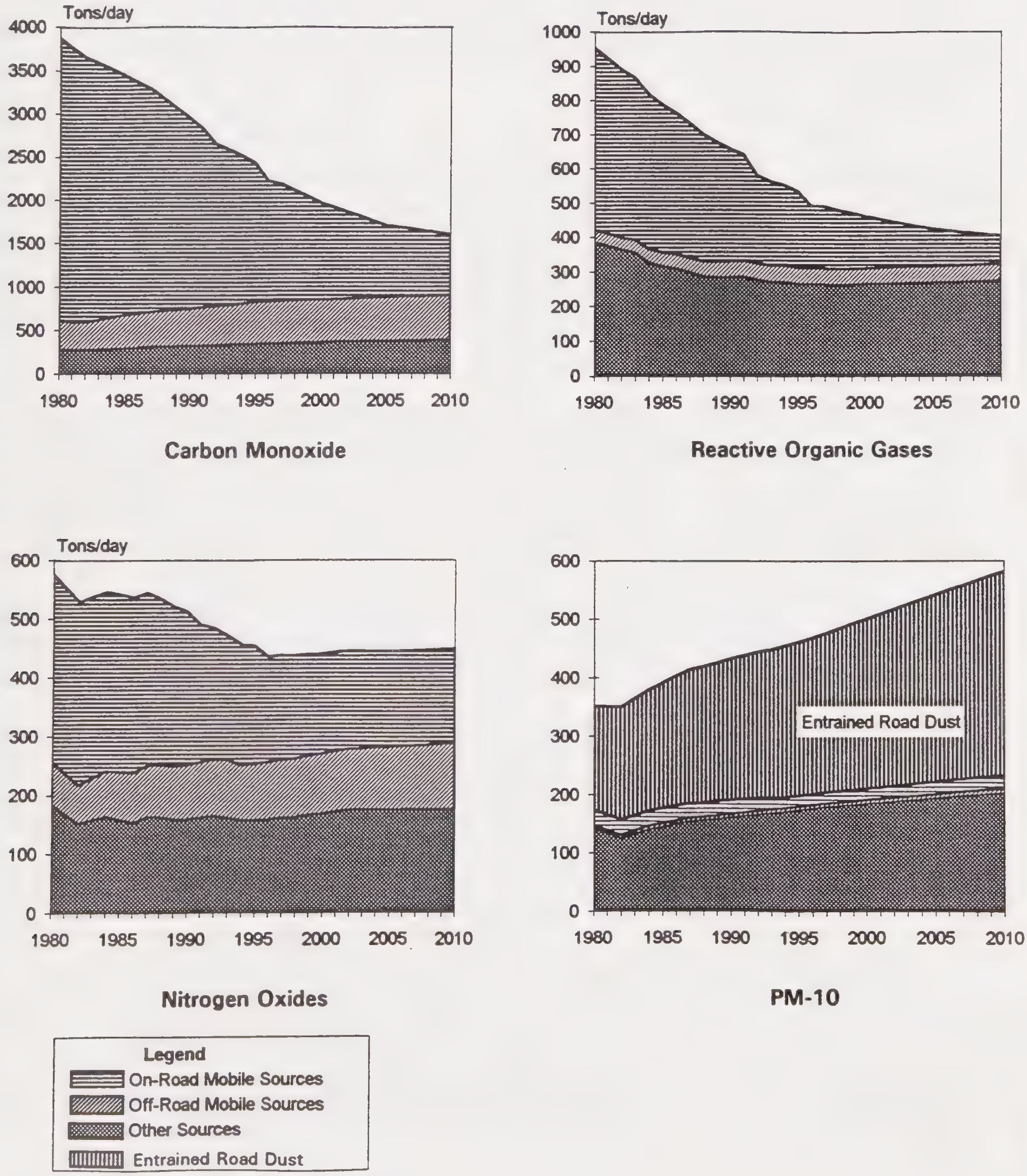

Table C-6 EMISSION INVENTORY SUMMARY: 1995 Contaminant Levels Annual Average (Tons/Day)

	Use-Category	Alameda	Contra Costa	Marin	Napa	SF	San Mateo	Santa Clara	Solano	Sonoma	District Total
Carbon Monoxide (CO)	Residential	41	28	10	5	21	22	45	10	18	198
	Commercial	19	15	4	2	7	11	22	4	9	94
	Industrial	10	43	2	1	5	5	22	3	4	94
	Infrastructure	0	6	0	0	1	0	1	0	0	9
	Construction	52	34	8	6	22	23	52	0	16	213
	Transportation	401	263	87	46	133	217	451	103	92	1792
	Agricultural & Natural	3	3	2	2	0	1	6	0	6	24
	Total	527	392	113	63	189	278	598	120	144	2425
Reactive Organic Gases (ROG)	Residential	14	9	3	1	8	7	15	3	4	63
	Commercial	17	13	3	2	11	9	21	3	4	82
	Industrial	22	31	1	1	5	7	16	6	3	90
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	3	2	0	0	1	1	3	0	1	13
	Transportation	57	38	12	7	19	33	63	21	13	262
	Agricultural & Natural	5	4	1	1	1	2	4	2	3	23
	Total	117	96	22	13	46	59	122	35	28	535
Nitrogen Oxides (NO_x)	Residential	6	4	1	1	4	3	6	1	1	26
	Commercial	0	0	0	0	0	0	0	0	0	0
	Industrial	11	48	0	0	2	2	14	10	1	89
	Infrastructure	1	21	0	0	6	1	4	0	0	34
	Construction	13	8	2	2	5	6	13	0	5	54
	Transportation	58	37	10	4	18	33	58	17	10	245
	Agricultural & Natural	1	1	1	1	0	0	1	0	2	6
	Total	89	120	15	8	34	45	95	28	20	454
Sulfur Dioxide (SO_2)	Residential	0	0	0	0	0	0	0	0	0	1
	Commercial	0	0	0	0	0	0	0	0	0	0
	Industrial	2	44	0	0	0	0	2	14	0	63
	Infrastructure	0	0	0	0	0	0	0	0	0	1
	Construction	1	1	0	0	0	1	1	0	1	5
	Transportation	8	7	1	0	8	2	3	2	1	31
	Agricultural & Natural	0	0	0	0	0	0	0	0	0	0
	Total	12	53	1	1	9	3	6	16	1	102
Fine Particulate Matter (PM_{10})	Residential	4	3	1	1	2	2	4	1	2	17
	Commercial	2	1	1	0	2	1	2	0	1	7
	Industrial	3	5	0	1	0	1	2	1	1	14
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	12	14	2	1	3	8	14	3	5	61
	Transportation	63	42	20	9	26	35	88	14	24	321
	Agricultural & Natural	4	6	3	1	4	5	9	6	3	41
	Total	88	70	26	12	36	52	119	24	35	462

NOTES: Reactive organic gas (ROG) tonnages exclude non-reactive hydrocarbons, such as methane and naturally occurring hydrocarbon emissions from vegetation. NOx tonnages are as NO_2. "Natural" PM_{10} includes wind-blown dust and ocean salt particles. Totals may differ slightly from sums of tabled values because of rounding. Projections are based on Base Year 1990 Air District Emission Inventory.

Table C-7 EMISSION INVENTORY SUMMARY: 2000 Contaminant Levels Annual Average (Tons/Day)

	Use-Category	Alameda	Contra Costa	Marin	Napa	SF	San Mateo	Santa Clara	Solano	Sonoma	District Total
Carbon Monoxide (CO)	Residential	43	29	11	5	22	23	47	10	19	208
	Commercial	15	12	3	2	6	9	18	3	7	74
	Industrial	11	46	2	1	5	6	24	3	4	102
	Infrastructure	0	7	0	0	1	0	1	0	0	11
	Construction	55	36	8	7	24	24	55	0	17	225
	Transportation	290	195	66	38	96	160	323	80	70	1318
	Agricultural & Natural	4	4	2	3	0	1	6	0	6	26
	Total	418	328	92	56	154	222	473	97	123	1963
Reactive Organic Gases (ROG)	Residential	14	9	3	1	8	7	16	3	4	65
	Commercial	15	11	3	2	10	9	19	3	3	75
	Industrial	22	31	1	1	5	7	16	5	3	91
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	3	2	0	0	1	1	3	0	1	13
	Transportation	41	28	9	6	14	25	44	18	9	194
	Agricultural & Natural	5	4	1	1	1	2	4	2	4	25
	Total	101	86	19	12	40	51	102	32	24	464
Nitrogen Oxides (NO_x)	Residential	6	4	1	1	4	3	6	1	1	26
	Commercial	0	0	0	0	0	0	0	0	0	1
	Industrial	11	50	0	0	2	2	15	11	1	93
	Infrastructure	1	25	0	0	7	1	5	0	0	39
	Construction	14	9	2	2	6	6	14	0	6	58
	Transportation	51	33	9	4	16	30	50	15	9	217
	Agricultural & Natural	1	1	1	1	0	0	1	0	2	6
	Total	85	122	14	8	34	42	90	27	19	441
Sulfur Dioxide (SO_2)	Residential	0	0	0	0	0	0	0	0	0	1
	Commercial	0	0	0	0	0	0	0	0	0	0
	Industrial	2	47	0	0	0	0	2	15	0	66
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	1	1	0	0	1	1	1	0	1	6
	Transportation	9	8	1	0	9	2	3	2	1	33
	Agricultural & Natural	0	0	0	0	0	0	0	0	0	1
	Total	12	56	1	1	10	3	7	17	1	107
Fine Particulate Matter (PM_{10})	Residential	4	2	1	1	2	2	4	1	1	18
	Commercial	1	1	1	0	1	1	1	1	1	8
	Industrial	4	5	0	1	0	1	3	1	1	15
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	13	15	2	1	2	9	16	3	5	66
	Transportation	70	46	22	10	29	39	97	15	27	355
	Agricultural & Natural	4	5	2	2	2	4	8	6	3	39
	Total	96	75	28	14	37	56	129	27	38	501

NOTES: Reactive organic (hydrocarbon or HC) tonnages exclude non-reactive hydrocarbons, such as methane and naturally occurring hydrocarbon emissions from vegetation. NOx tonnages are as NO_2. "Natural" PM_{10} includes wind-blown dust and ocean salt particles. Totals may differ slightly from sums of tabled values because of rounding. Projections are based on Base Year 1990 Air District Emission Inventory.

Table C-8 EMISSION INVENTORY SUMMARY: 2010 Contaminant Levels Annual Average (Tons/Day)

	Use-Category	Alameda	Contra Costa	Marin	Napa	SF	San Mateo	Santa Clara	Solano	Sonoma	District Total
Carbon Monoxide (CO)	Residential	45	31	11	5	24	24	50	11	20	222
	Commercial	7	5	2	1	3	4	8	1	3	33
	Industrial	13	51	2	1	6	6	27	3	4	113
	Infrastructure	1	7	0	0	1	0	1	0	0	10
	Construction	62	40	9	8	27	28	62	0	19	254
	Transportation	204	142	51	33	64	114	210	67	52	938
	Agricultural & Natural	4	4	3	3	0	1	7	0	7	29
	Total	336	281	77	51	124	177	365	83	106	1600
Reactive Organic Gases (ROG)	Residential	15	9	3	1	9	8	17	3	4	70
	Commercial	15	11	3	2	10	8	18	3	3	72
	Industrial	23	31	1	1	5	6	17	6	2	93
	Infrastructure	0	1	0	0	0	0	0	0	0	2
	Construction	4	2	1	0	2	2	3	0	1	15
	Transportation	26	19	6	5	8	17	25	15	6	128
	Agricultural & Natural	5	4	1	1	1	2	4	2	4	27
	Total	88	78	16	11	34	43	86	29	21	406
Nitrogen Oxides (NO_x)	Residential	6	4	1	1	4	3	6	1	1	27
	Commercial	0	0	0	0	0	0	0	0	0	1
	Industrial	13	52	1	1	2	2	17	11	1	100
	Infrastructure	1	23	0	0	6	1	5	0	0	37
	Construction	16	10	2	2	6	7	15	0	6	65
	Transportation	51	32	9	4	15	29	48	16	9	212
	Agricultural & Natural	1	1	1	1	0	0	1	0	2	7
	Total	88	122	14	8	33	42	93	28	20	449
Sulfur Dioxide (SO_2)	Residential	0	0	0	0	0	0	0	0	0	1
	Commercial	0	0	0	0	0	0	0	0	0	0
	Industrial	2	48	0	0	0	0	2	15	0	68
	Infrastructure	0	1	0	0	1	0	0	0	0	1
	Construction	2	1	0	0	1	1	1	0	1	6
	Transportation	10	9	1	0	10	2	3	2	1	37
	Agricultural & Natural	0	0	0	0	0	0	0	0	0	1
	Total	14	58	1	1	11	3	7	17	2	115
Fine Particulate Matter (PM_{10})	Residential	4	3	1	1		1	4	1	2	18
	Commercial	2	1	1	0	2	1	2	1	1	11
	Industrial	4	5	0	1	1	2	3	1	1	17
	Infrastructure	0	1	0	0	0	0	0	0	0	1
	Construction	14	16	2	2	3	10	17	4	6	73
	Transportation	84	56	27	12	35	46	114	18	32	423
	Agricultural & Natural	4	6	2	1	3	5	9	6	3	40
	Total	112	89	32	16	45	65	149	30	46	582

NOTES: Reactive organic gas (ROG) tonnages exclude non-reactive hydrocarbons, such as methane and naturally occurring hydrocarbon emissions from vegetation. NOx tonnages are as NO_2. "Natural" PM_{10} includes wind-blown dust and ocean salt particles. Totals may differ slightly from sums of tabled values because of rounding. Projections are based on Base Year 1990 Air District Emission Inventory.

Transport of Pollutants

The California Clean Air Act, Section 39610 (a), directs the ARB to "identify each district in which transported air pollutants from upwind areas outside the district cause or contribute to a violation of the ozone standard and to identify the district of origin of transported pollutants." The information regarding the transport of air pollutants from one basin to another was to be quantified to assist interrelated basins in the preparation of plans for the attainment of State ambient air quality standards.

Numerous studies conducted by the ARB have identified air basins that are impacted by pollutants transported from other air basins (as of 1993). Among the air basins affected by air pollution transport from the Bay Area are the North Central Coast Air Basin, the Mountain Counties Air Basin, the San Joaquin Valley Air Basin, and the broader Sacramento Area. The Bay Area was also identified as an area impacted by the transport of air pollutants from the Sacramento area.

Other possible transport corridors being studied by the District and the ARB are from the Bay Area to the Upper Sacramento Valley and from the San Joaquin Valley Air Basin to the Bay Area.

Toxic Air Contaminants

The District has established a number of monitoring stations to track ambient levels of 11 toxic air pollutants: benzene, 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), chloroform (TCM), 1,2-dichloroethane (EDC), 1,2-dibromoethane (EDB), methylene dichloride (DCM), carbon tetrachloride, tetrachloroethylene (perc), vinyl chloride, and toluene. The District is also in the process of establishing a monitoring network to trace 1,3-butadiene. Of the toxics monitored by the District, State ambient air quality standards have been set only for vinyl chloride. (Other toxic substances are regulated or controlled through risk assessment and risk management programs. See Appendix E.)

Because the District's air toxics monitoring program is relatively new, little trend information is available. Based on ARB information, it is expected that benzene and 1,3-butadiene — both generated largely by motor vehicles — will be reduced substantially when reformulated fuels are introduced. These two toxic compounds together account for more than half the background health risk from identified air toxics.

Global Warming and Stratospheric Ozone Depletion

Global warming and stratospheric ozone depletion are issues which have gained increased public attention over the last decade. Unlike emissions of criteria and toxic air pollutants, which have local or regional impacts, emissions contributing to global warming and ozone depletion have a broader, global impact.

Global warming is a process whereby "greenhouse gases" accumulating in the atmosphere contribute to an increase in the temperature of the earth's atmosphere. The principal compounds contributing to global warming are carbon dioxide (CO_2), methane, nitrous oxide, ozone and water vapor. These gases allow visible and ultraviolet light from the sun to pass through the atmosphere, but they prevent heat from escaping back out into space. Among the potential implications of global warming are rising sea levels, climate changes and adverse impacts to agriculture, forestry and natural habitats. In addition, global warming may increase electricity demand for cooling, decrease the availability of hydroelectric power, and affect regional air quality and human health. Like most criteria and toxic pollutants, much of the greenhouse gas production comes from motor vehicles. Greenhouse gas emissions can be reduced to some degree by improved coordination of land use and transportation planning on the city, county and subregional level and other measures to reduce auto use. Energy conservation measures also can contribute to reductions in greenhouse gas emissions.

One group of greenhouse gases, chlorinated fluorocarbons (CFCs) also depletes stratospheric ozone in addition to causing global warming. Ozone in the stratosphere, unlike ground-level ozone, is beneficial. It acts as a solar radiation "screen" reducing the amount of short-wave ultraviolet radiation which can cause skin cancer, damage agricultural crops and increase photochemical smog. By depleting ozone in the upper atmosphere, CFCs not only allow more short-wave ultraviolet radiation to enter the earth's atmosphere, but they are several thousand times more effective than CO_2 in trapping infrared radiation. Since the mid-1930s, CFCs have been used as refrigerants, solvents, and in the production of foam materials. Moreover, CFCs survive in the atmosphere for decades.

National and international agreements have been made to control CFCs and to study air quality problems related to ozone depletion. Recent laws and practices governing repair and recharging of air conditioners and refrigerators have served to reduce CFC emissions. Although local governments alone cannot solve these global problems, some cities in the Bay Area have already demonstrated that local and regional efforts can make a contribution, e.g., banning the sale and commercial use of plastics made with CFCs.

APPENDIX D - CLIMATE, TOPOGRAPHY AND AIR POLLUTION POTENTIAL

Appendix D provides climatological and topographic information about the Bay Area, and explains how these natural factors influence air quality conditions. The first two sections address region-wide conditions relevant to all cities and counties in the Bay Area. The final sections discuss climatological subregions in the Bay Area.

BAY AREA CLIMATE AND TOPOGRAPHY

High Pressure Cell

During the summer, the large-scale meteorological condition that dominates the West Coast is a semipermanent high pressure cell centered over the northeastern Pacific Ocean. This high pressure cell keeps storms from affecting the California coast. Hence, the Bay Area experiences little precipitation in the summer months. Winds tend to blow on shore out of the north/northwest.

The steady northwesterly flow induces upwelling of cold water from below. This upwelling produces a band of cold water off the California coast. When air approaches the California coast, already cool and moisture-laden from its long journey over the Pacific, it is further cooled as it crosses this bank of cold water. This cooling often produces condensation resulting in a high incidence of fog and stratus clouds along the Northern California coast in the summer.

Generally in the winter, the Pacific high weakens and shifts southward, winds tend to flow offshore, upwelling ceases and storms occur. During the winter rainy periods, inversions (layers of warmer air over colder air; see below) are weak or nonexistent, winds are usually moderate and air pollution potential is low. The Pacific high does periodically become dominant however, bringing strong inversions, light winds and high pollution potential.

Topography

Bay Area topography is characterized by complex terrain, consisting of coastal mountain ranges, inland valleys and bays. This complex terrain, especially the higher elevations, distorts the normal wind flow patterns in the Bay Area. The greatest distortion occurs when low-level inversions are present and the air beneath the inversion flows independently of air above the inversion, a condition that is common in the summer time.

The only major break in California's Coast Range occurs in the Bay Area. Here the Coast Range splits into western and eastern ranges. Between the two ranges lies San Francisco Bay. The gap in the western coast range is known as the Golden Gate, and the gap in the eastern coast range is the Carquinez Strait. These gaps allow air to pass into and out of the Bay Area and the Central Valley.

Wind Patterns

During the summer, winds flowing from the northwest are drawn inland through the Golden Gate and over the lower portions of the San Francisco Peninsula. Immediately south of Mount Tamalpais, the northwesterly winds accelerate considerably and come more directly from the west as they stream through the Golden Gate. This channeling of wind through the Golden Gate produces a jet that sweeps eastward and splits off to the northwest toward Richmond and to the southwest toward San Jose when it meets the East Bay hills.

Wind speeds may be strong locally in areas where air is channeled through a narrow opening, such as the Carquinez Strait, the Golden Gate or the San Bruno gap. For example, the average wind speed at San Francisco International Airport in July is about 17 knots (from 3 p.m. to 4 p.m.), compared with only 7 knots at San Jose and less than 6 knots at the Farallon Islands.

The air flowing in from the coast to the Central Valley, called the sea breeze, begins developing at or near ground level along the coast in late morning or early afternoon. As the day progresses, the sea breeze layer deepens and increases in velocity while spreading inland. The depth of the sea breeze depends in large part upon the height and strength of the inversion. If the inversion is low and strong, and hence stable, the flow of the sea breeze will be inhibited and stagnant conditions are likely to result.

In the winter, the Bay Area frequently experiences stormy conditions with moderate to strong winds, as well as periods of stagnation with very light winds. Winter stagnation episodes are characterized by nighttime drainage flows in coastal valleys. Drainage is a reversal of the usual daytime air-flow patterns; air moves from the Central Valley toward the coast and back down toward the Bay from the smaller valleys within the Bay Area.

Temperature

Summertime temperatures in the Bay Area are determined in large part by the effect of differential heating between land and water surfaces. Because land tends to heat up and cool off more quickly than water, a large-scale gradient (differential) in temperature is often created between the coast and the Central Valley, and small-scale local gradients are often produced along the shorelines of the ocean and bays. The temperature gradient near the ocean is also exaggerated, especially in summer, because of the upwelling of cold ocean bottom water along the coast. Thus, on summer afternoons the temperatures at the coast can be 35°F cooler than temperatures 15 to 20 miles inland. At night this contrast usually decreases to less than 10°.

In the winter, the relationship of minimum and maximum temperatures is reversed. During the daytime the temperature contrast between the coast and inland areas is small, whereas at night the variation in temperature is large.

Precipitation

The Bay Area is characterized by moderately wet winters and dry summers. Winter rains account for about 75 percent of the average annual rainfall. The amount of annual precipitation can vary greatly from one part of the Bay Area to another even within short distances. In general, total annual rainfall can reach 40 inches in the mountains, but it is often less than 16 inches in sheltered valleys.

During rainy periods, ventilation (rapid horizontal movement of air and injection of cleaner air) and vertical mixing are usually high, and thus pollution levels tend to be low. However, frequent dry periods do occur during the winter where mixing and ventilation are low and pollutant levels build up.

AIR POLLUTION POTENTIAL

The potential for high pollutant concentrations developing at a given location depends upon the quantity of pollutants emitted into the atmosphere in the surrounding area or upwind, and the ability of the atmosphere to disperse the contaminated air. The topographic and climatological factors discussed above influence the atmospheric pollution potential of an area. Atmospheric pollution potential, as the term is used here, is independent of the location of emission sources and is instead a function of factors described below.

Wind Circulation

Low wind speed contributes to the buildup of air pollution because it allows more pollutants to be emitted into the air mass per unit of time. Light winds occur most frequently during periods of low sun (fall and winter, and early morning) and at night. These are also periods when air pollutant emissions from some sources are at their peak, namely, commute traffic (early morning) and wood burning appliances (nighttime). The problem can be compounded in valleys, when weak flows carry the pollutants upvalley during the day, and cold air drainage flows move the air mass downvalley at night. Such restricted movement of trapped air provides little opportunity for ventilation and leads to buildup of pollutants to potentially unhealthful levels.

Wind-roses (Figure D-1) provide useful information for communities that contain industry, landfills or other potentially odorous or noxious land uses. Each wind-rose diagram provides a general indication of the proportion of time that winds blow from each compass direction. The longer the vector length, the greater the frequency of wind occurring from that direction. Such information may be particularly useful in planning buffer zones. For example, sensitive receptors such as residential developments, schools or hospitals are inappropriate uses immediately downwind from facilities that emit toxic or odorous pollutants, unless adequate separation is provided by a buffer zone. Caution should be taken, however, in using wind-roses in planning and environmental review processes. A site on the opposite side of a hill or tall building, even a short distance from a meteorological monitoring station, may experience a significant difference in wind pattern. Figure D-1 is a map of simplified wind roses, composed of data from a number of Bay Area meteorological stations. Lead agencies should consult District meteorologists if more detailed information is needed.

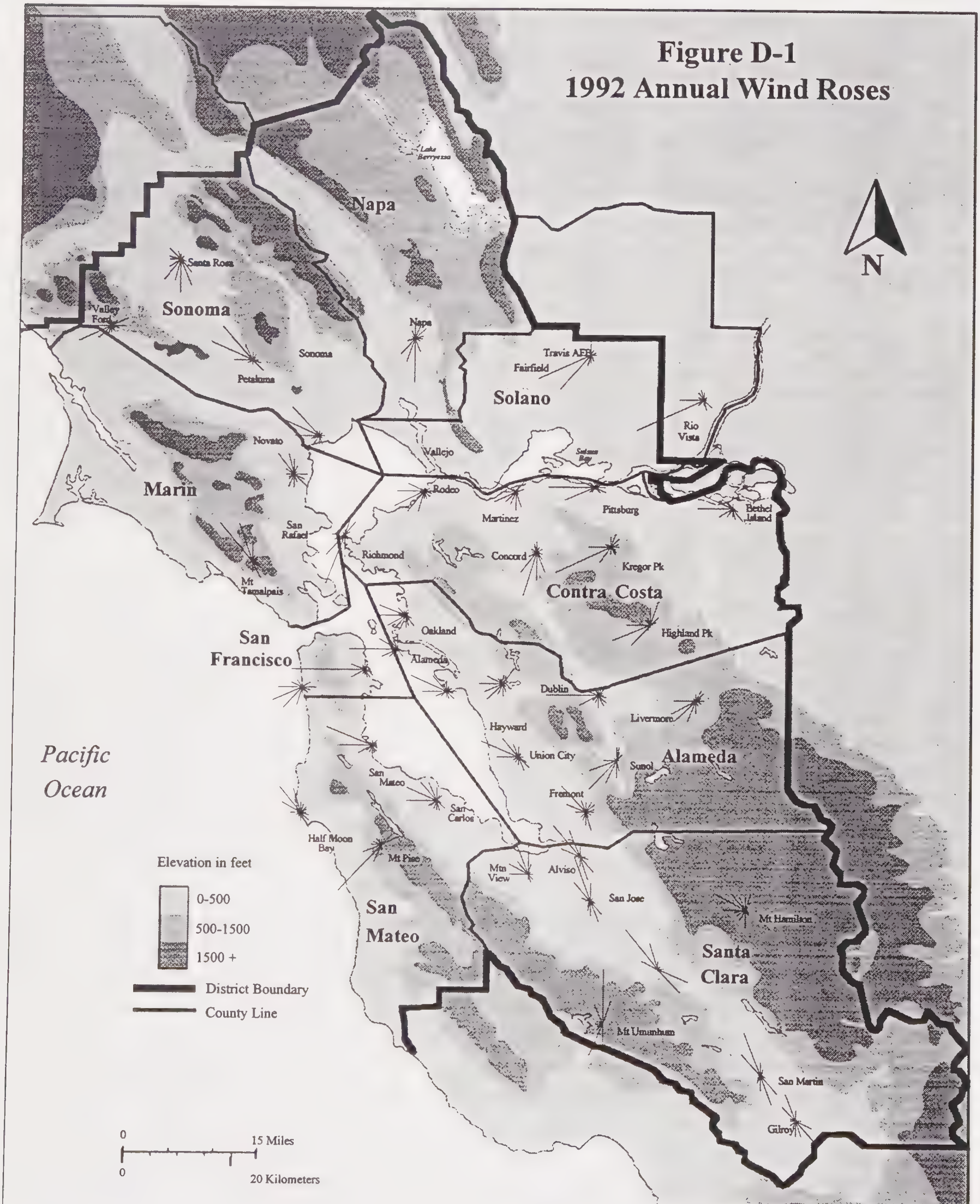

Figure D-1
1992 Annual Wind Roses

Inversions

An inversion is a layer of warmer air over a layer of cooler air. Inversions affect air quality conditions significantly because they influence the mixing depth, i.e., the vertical depth in the atmosphere available for diluting air contaminants near the ground. The highest air pollutant concentrations in the Bay Area generally occur during inversions.

There are two types of inversions that occur regularly in the Bay Area. One is more common in the summer and fall, while the other is most common during the winter. The frequent occurrence of elevated temperature inversions in summer and fall months acts to cap the mixing depth and consequently limit the depth of air available for dilution. Elevated inversions are caused by subsiding air from the subtropical high pressure zone, and from the cool marine air layer that is drawn into the Bay Area by the heated low pressure region in the Central Valley.

The inversions typical of winter, called radiation inversions, are formed as heat quickly radiates from the earth's surface after sunset, causing the air in contact with it to rapidly cool. Radiation inversions are strongest on clear, low-wind, cold winter nights, allowing the build-up of such pollutants as carbon monoxide and particulate matter. When wind speeds are low, there is little mechanical turbulence to mix the air, resulting in a layer of warm air over a layer of cooler air next to the ground. Mixing depths under these conditions can be as shallow as 50 to 100 meters, particularly in rural areas. Urban areas usually have deeper minimum mixing layers because of heat island effects and increased surface roughness. During radiation inversions downwind transport is slow, the mixing depths are shallow, and turbulence is minimal. All of these factors contribute to increased pollution levels near the ground.

Although each type of inversion is most common during a specific season, either inversion mechanism can occur at any time of the year. Sometimes both occur simultaneously. Moreover, the characteristics of an inversion often change throughout the course of a day. The terrain of the Bay Area also induces significant variations among subregions.

Stability

Stability is defined as the atmosphere's resistance to vertical motions. The more stable the air, the slower the mixing, resulting in increased probability for air pollutants to build up and exceed ambient air quality standards.

The stability of the atmosphere is highly dependent upon the vertical distribution of temperature with height. When the temperature decreases vertically ("lapse rate") at 10 degrees Celsius per 1000 meters, the atmosphere is classified as "neutral stability". When the lapse rate is greater than 10 degrees C per 100 meters, the atmosphere is "unstable". If the lapse rate is less than 10 degrees per 1000 meters, or the temperature increases with height, the atmosphere is "stable". These stabilities have been categorized for use in dispersion models. Stability categories range from "Extremely Unstable" (Stability Class A), through "Neutral" (D), to "Stable" (F).

Unstable conditions can only occur during daytime hours when solar heating warms the lower layers sufficiently. Under A stability conditions, large horizontal wind direction fluctuations

occur, along with large vertical mixing. These motions usually only occur midday during summer months on cloudless days with light winds. Under B stability conditions, wind direction fluctuations and vertical mixing are less pronounced, because the heating is less strong. The fluctuations found during both A and B stability conditions are mostly due to thermal turbulence. Under C stability conditions, the solar insulation is weaker, or the wind speeds are stronger, so that the surface heating is weaker. The horizontal and vertical fluctuations are weaker yet, and are caused by a combination of thermal and mechanical turbulence.

D stability can occur either during the day or at night. Under D stability conditions, the wind speeds are usually strong — greater than 5 meters per second — or the sky is obscured by clouds. Wind direction fluctuations are small, while vertical motions are primarily generated by mechanical turbulence.

Stabilities E and F can only occur at night. The necessary conditions can only occur in the absence of sunlight, and with light to moderate winds. Under these conditions, there is little turbulence because of the atmosphere's resistance to vertical motion. Pollutants emitted into a stable air mass will travel downwind with little dispersion.

Solar Radiation

The frequency of hot, sunny days during the summer months in the Bay Area is another important factor that affects air pollution potential. It is at the higher temperatures that ozone is formed. In the presence of ultraviolet sunlight and warm temperatures, reactive organic gases and oxides of nitrogen react to form secondary photochemical pollutants, including ozone. Because temperatures in many of the Bay Area inland valleys are so much higher than near the coast, the inland areas are especially prone to photochemical air pollution.

In late fall and winter, solar angles are low, resulting in insufficient ultraviolet light and warming of the atmosphere to drive the photochemical reactions. Consequently, ozone concentrations do not reach significant levels in the Bay Area during these seasons.

Sheltered Terrain

The hills and mountains in the Bay Area contribute to the high pollution potential of some areas. During the day, or at night during windy conditions, areas in the lee sides of mountains are sheltered from the prevailing winds, thereby reducing turbulence and downwind transport. At night, when wind speeds are low, the upper atmospheric layers are often decoupled from the surface layers during radiation conditions. If elevated terrain is present, it will tend to block pollutant transport in that direction. Elevated terrain also can create a recirculation pattern by inducing upvalley air flows during the day and reverse downvalley flows during the night, allowing little inflow of fresh air.

The areas having the highest air pollution potential tend to be those that experience the highest temperatures in the summer and the lowest temperatures in the winter. Bay Area coastal areas are exposed to the prevailing marine air and consequently have cooler temperatures in the summer, warmer temperatures in winter, and experience stratus clouds all year. The inland

valleys are sheltered from the marine air and consequently experience hotter summers and colder winters. Thus, the topography of the inland valleys creates conditions conducive to high air pollution potential.

Pollution Potential Related to Emissions

Although air pollution potential is strongly influenced by climate and topography, the air pollution that occurs in a location also depends upon the amount of air pollutant emissions in the surrounding area or transported from more distant places. Air pollutant emissions generally are highest in areas that have high population densities, high motor vehicle use and/or industrialization. However, contaminants created by photochemical processes in the atmosphere, such as ozone, may result in high concentrations many miles downwind from the sources of their precursor chemicals.

CLIMATOLOGICAL SUBREGIONS

This section discusses the varying climatological and topographic conditions, and the resulting variations in air pollution potential, within inhabited subregions of the Bay Area Air Basin. All urbanized areas of the Bay Area are included in one of 11 climatological subregions. Sparsely inhabited areas are excluded from the subregional designations. Some of the climatological subregions discussed in this appendix overlap county boundaries. Lead Agencies analyzing projects located close to the boundary between subregions may need to examine the characteristics of the neighboring subregions in order to adequately evaluate potential air quality impacts. The 11 subregions are portrayed in Figure D-2.

The information about each subregion includes location, topography and climatological factors relevant to air quality. Where relevant to air quality concerns, more localized subareas within a subregion are discussed. Each subregional section concludes with a discussion of pollution potential resulting from climatological and topographic variables and the major types of air pollutant sources in the subregion.

Carquinez Strait Region

The Carquinez Strait runs from Rodeo to Martinez. It is the only sea-level gap between San Francisco Bay and the Central Valley. The subregion includes the lowlands bordering the strait to the north and south, and includes the area adjoining Suisun Bay and the western part of the Sacramento-San Joaquin Delta as far east as Bethel Island. The subregion extends from Rodeo in the southwest and Vallejo in the northwest to Fairfield on the northeast and Brentwood on the southeast.

Prevailing winds are from the west in the Carquinez Strait. During the summer and fall months, high pressure offshore coupled with low pressure in the Central Valley causes marine air to flow eastward through the Carquinez Strait. The wind is strongest in the afternoon. Afternoon wind speeds of 15 to 20 mph are common throughout the strait region. Annual average wind speeds

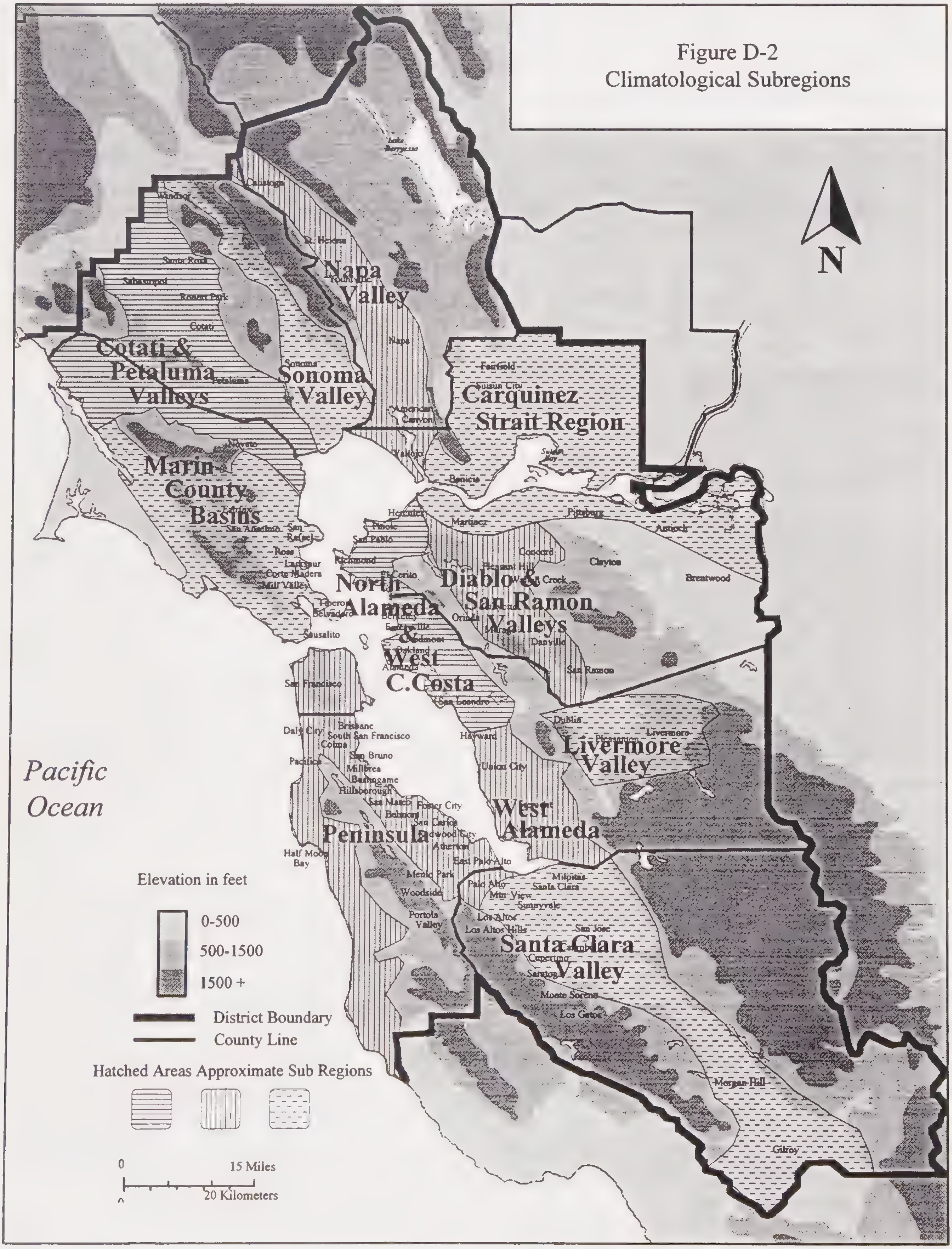

Figure D-2
Climatological Subregions

are 8 mph in Martinez, and 9 to 10 mph further east. Sometimes atmospheric conditions cause air to flow from the east. East winds usually contain more pollutants than the cleaner marine air from the west. In the summer and fall months, this can cause elevated pollutant levels to move into the central Bay Area through the strait. These high pressure periods are usually accompanied by low wind speeds, shallow mixing depths, higher temperatures and little or no rainfall.

Summer mean maximum temperatures reach about 90° F. in the subregion. Mean minimum temperatures in the winter are in the high 30's. Temperature extremes are especially pronounced in sheltered areas farther from the moderating effects of the strait itself, e.g. at Fairfield.

Many industrial facilities with significant air pollutant emissions — e.g., chemical plants and refineries — are located within the Carquinez Strait Region. The pollution potential of this area is often moderated by high wind speeds. However, upsets at industrial facilities can lead to short-term pollution episodes, and emissions of unpleasant odors may occur at anytime. Receptors downwind of these facilities could suffer more long-term exposure to air contaminants than individuals elsewhere. Consequently, it is important that local governments and other Lead Agencies maintain buffers zones around sources of air pollution sufficient to avoid adverse health and nuisance impacts on nearby receptors. Areas of the subregion that are traversed by major roadways, e.g. Interstate 80, may also be subject to higher local concentrations of carbon monoxide and particulate matter, as well as certain toxic air contaminants such as benzene.

Cotati and Petaluma Valleys

The subregion that stretches from Santa Rosa to the San Pablo Bay is often considered as two different valleys: the Cotati Valley in the north and the Petaluma Valley in the south. To the east, the valley is bordered by the Sonoma Mountains, while to the west is a series of low hills, followed by the Estero Lowlands, which open to the Pacific Ocean. The region from the Estero Lowlands to the San Pablo Bay is known as the Petaluma Gap. This low-terrain area allows marine air to travel into the Bay Area.

Wind patterns in the Petaluma and Cotati Valleys are strongly influenced by the Petaluma Gap, with winds flowing predominantly from the west. As marine air travels through the Petaluma Gap, it splits into northward and southward paths moving into the Cotati and Petaluma valleys. The southward path crosses San Pablo Bay and moves eastward through the Carquinez Strait. The northward path contributes to Santa Rosa's prevailing winds from the south and southeast. Petaluma's prevailing winds are from the northwest.

When the ocean breeze is weak, strong winds from the east can predominate, carrying pollutants from the Central Valley and the Carquinez Strait. During these periods, upvalley flows can carry the polluted air as far north as Santa Rosa.

Winds are usually stronger in the Petaluma Valley than the Cotati Valley because the former is directly in line with the Petaluma Gap. Consequently, Petaluma's climate is similar to areas closer to the coast even though Petaluma is 28 miles from the ocean. Average annual wind speed

at the Petaluma Airport is seven mph. The Cotati Valley, being slightly north of the Petaluma Gap, experiences lower wind speeds. The annual average wind speed in Santa Rosa is five mph.

Air temperatures are very similar in the two valleys. Summer maximum temperatures for this subregion are in the low-to-mid-80's, while winter maximum temperatures are in the high-50's to low-60's. Summer minimum temperatures are around 50 degrees, and winter minimum temperatures are in the high 30's.

Generally, air pollution potential is low in the Petaluma Valley because of its link to the Petaluma Gap and because of its low population density. However, there are two scenarios that could produce elevated pollutant levels: 1) stagnant conditions in the morning hours created when a weak ocean breeze meets a weak bay breeze, and 2) an eastern or southeastern wind pattern in the afternoon brings in pollution from the Carquinez Strait Region and the Central Valley.

The Cotati Valley has a higher pollution potential than does the Petaluma Valley. The Cotati Valley lacks a gap to the sea, contains a larger population and has natural barriers at its northern and eastern ends. There are also industrial facilities in and around Santa Rosa. Both valleys of this subregion are also threatened by increased motor vehicle traffic and the associated air contaminants. Population and motor vehicle use are increasing significantly, and housing costs and the suburbanization of employment are leading to more and longer commutes traversing the subregion.

Diablo and San Ramon Valleys

East of the Coast Range lie the Diablo and San Ramon Valleys. The valleys have a northwest to southeast orientation, with the northern portion known as Diablo Valley and the southern portion as San Ramon Valley. The Diablo Valley is bordered in the north by the Carquinez Strait and in the south by the San Ramon Valley. The San Ramon Valley is long and narrow and extends south from Walnut Creek to Dublin. At its southern end it opens onto the Amador Valley.

The mountains on the west side of these valleys block much of the marine air from reaching the valleys. During the daytime, there are two predominant flow patterns: an upvalley flow from the north and a westerly flow (wind from the west) across the lower elevations of the Coast Range. On clear nights, surface inversions separate the flow of air into two layers: the surface flow and the upper layer flow. When this happens, there are often drainage surface winds which flow downvalley toward the Carquinez Strait.

Wind speeds in these valleys generally are low. Monitoring stations in Concord and Danville report annual average wind speeds of 5 mph. However, winds can increase in the afternoon near San Ramon because it is located at the eastern edge of the Crow Canyon gap. Through this gap, polluted air from cities near the bay travels to the valley in the summer months.

Air temperatures in these valleys are cooler in the winter and warmer in the summer than are temperatures further west, as these valleys are far from the moderating effect of the bay and

ocean. Mean summer maximum temperatures are in the low- to mid-80's. Mean winter minimum temperatures are in the high-30's to low-40's.

Pollution potential is relatively high in these valleys. On winter evenings, light winds combined with surface-based inversions and terrain that restricts air flow can cause pollutant levels to build up. San Ramon Valley can experience high pollution concentrations due to motor vehicle emissions and emissions from fireplaces and wood stoves. In the summer months, ozone and ozone precursors are often transported into the valleys from both the central Bay Area and the Central Valley.

Livermore Valley

The Livermore Valley is a sheltered inland valley near the eastern border of the District. The western side of the valley is bordered by 1,000 to 1,500 foot hills with two gaps connecting the valley to the central Bay Area, the Hayward Pass and Niles Canyon. The eastern side of the valley also is bordered by 1,000 to 1,500 foot hills with one major passage to the San Joaquin Valley called the Altamont Pass and several secondary passages. To the north lie the Black Hills and Mount Diablo. A northwest to southeast channel connects the Diablo Valley to the Livermore Valley. The south side of the Livermore Valley is bordered by mountains approximately 3,000 to 3,500 feet high.

During the summer months, when there is a strong inversion with a low ceiling, air movement is weak and pollutants become trapped and concentrated. Maximum summer temperatures in the Livermore Valley range from the high-80's to the low-90's, with extremes in the 100's. At other times in the summer, a strong Pacific high pressure cell from the west, coupled with hot inland temperatures causes a strong onshore pressure gradient which produces a strong, afternoon wind. With a weak temperature inversion, air moves over the hills with ease, dispersing pollutants.

In the winter, with the exception of an occasional storm moving through the area, air movement is often dictated by local conditions. At night and early morning, especially under clear, calm and cold conditions, gravity drives cold air downward. The cold air drains off the hills and moves into the gaps and passes. On the eastern side of the valley the prevailing winds blow from north, northeast and east out of the Altamont Pass. Winds are light during the late night and early morning hours. Winter daytime winds sometimes flow from the south through the Altamont Pass to the San Joaquin Valley. Average winter maximum temperatures range from the high-50's to the low-60's, while minimum temperatures are from the mid-to-high-30's, with extremes in the high teens and low-20's.

Air pollution potential is high in the Livermore Valley, especially for photochemical pollutants in the summer and fall. High temperatures increase the potential for ozone to build up. The valley not only traps locally generated pollutants but can be the receptor of ozone and ozone precursors from San Francisco, Alameda, Contra Costa and Santa Clara counties. On northeasterly wind flow days, most common in the early fall, ozone may be carried west from the San Joaquin Valley to the Livermore Valley.

During the winter, the sheltering effect of the valley, its distance from moderating water bodies, and the presence of a strong high pressure system contribute to the development of strong, surface-based temperature inversions. Pollutants such as carbon monoxide and particulate matter, generated by motor vehicles, fireplaces and agricultural burning, can become concentrated. Air pollution problems could intensify because of population growth and increased commuting to and through the subregion.

Marin County Basins

Marin County is bounded on the west by the Pacific Ocean, on the east by San Pablo Bay, on the south by the Golden Gate and on the north by the Petaluma Gap. Most of Marin's population lives in the eastern part of the county, in small, sheltered valleys. These valleys act like a series of miniature air basins.

Although there are a few mountains above 1500 feet, most of the terrain is only 800 to 1000 feet high, which usually is not high enough to block the marine layer. Because of the wedge shape of the county, northeast Marin County is further from the ocean than is the southeastern section. This extra distance from the ocean allows the marine air to be moderated by bayside conditions as it travels to northeastern Marin County. In southern Marin the distance from the ocean is short and elevations are lower, resulting in higher incidence of maritime air in that area.

Wind speeds are highest along the west coast of Marin, averaging about 8 to 10 miles per hour. The complex terrain in central Marin creates sufficient friction to slow the air flow. At Hamilton Air Force Base, in Novato, the annual average wind speeds are only 5 mph. The prevailing wind directions throughout Marin County are generally from the northwest.

In the summer months, areas along the coast are usually subject to onshore movement of cool marine air. In the winter, proximity to the ocean keeps the coastal regions relatively warm, with temperatures varying little throughout the year. Coastal temperatures are usually in the high-50's in the winter and the low-60's in the summer. The warmest months are September and October.

The eastern side of Marin County has warmer weather than the western side because of its distance from the ocean and because the hills that separate eastern Marin from western Marin occasionally block the flow of the marine air. The temperatures of cities next to the bay are moderated by the cooling effect of the bay in the summer and the warming effect of the bay in the winter. For example, San Rafael experiences average maximum summer temperatures in the low-80's and average minimum winter temperatures in the low-40's. Inland towns such as Kentfield experience average maximum temperatures that are two degrees cooler in the winter and two degrees warmer in the summer.

Air pollution potential is highest in eastern Marin County, where most of population is located in semi-sheltered valleys. In the southeast, the influence of marine air keeps pollution levels low. However, as development moves further north, there is greater potential for air pollution to build up because the valleys are more sheltered from the sea breeze. While Marin County does not have many polluting industries, the air quality on its eastern side — especially along the U.S. 101

corridor — may be affected by emissions from increasing motor vehicle use within and through the county.

Napa Valley

The Napa Valley is bordered by relatively high mountains. With an average ridge line height of about 2000 feet, with some peaks approaching 3000 to 4000 feet, these mountains are effective barriers to the prevailing northwesterly winds. The Napa Valley is widest at its southern end and narrows in the north.
During the day, the prevailing winds flow upvalley from the south about half of the time. A strong upvalley wind frequently develops during warm summer afternoons, drawing air in from the San Pablo Bay. Daytime winds sometimes flow downvalley from the north. During the evening, especially in the winter, downvalley drainage often occurs. Wind speeds are generally low, with almost 50 percent of the winds less than 4 mph. Only 5 percent of the winds are between 16 and 18 mph, representing strong summertime upvalley winds and winter storms.

Summer average maximum temperatures are in the low 80's at the southern end of the valley and in the low 90's at the northern end. Winter average maximum temperatures are in the high-50's and low-60's, and minimum temperatures are in the high to mid 30's with the slightly cooler temperatures in the northern end.

The air pollution potential in the Napa Valley could be high if there were sufficient sources of air contaminants nearby. Summer and fall prevailing winds can transport ozone precursors northward from the Carquinez Strait Region to the Napa Valley, effectively trapping and concentrating the pollutants when stable conditions are present. The local upslope and downslope flows created by the surrounding mountains may also recirculate pollutants already present, contributing to buildup of air pollution. High ozone concentrations are a potential problem to sensitive crops such as wine grapes, as well as to human health. The high frequency of light winds and stable conditions during the late fall and winter contribute to the buildup of particulate matter from motor vehicles, agriculture and woodburning in fireplaces and stoves.

Northern Alameda and Western Contra Costa Counties

This climatological subregion stretches from Richmond to San Leandro. Its western boundary is defined by San Francisco Bay and its eastern boundary by the Oakland-Berkeley Hills. The Oakland-Berkeley Hills have a ridge line height of approximately 1500 feet, a significant barrier to air flow. The most densely populated area of the subregion lies in a strip of land between the bay and the lower hills.

In this area, marine air traveling through the Golden Gate, as well as across San Francisco and through the San Bruno Gap, is a dominant weather factor. The Oakland-Berkeley Hills cause the westerly flow of air to split off to the north and south of Oakland, which causes diminished wind speeds. The prevailing winds for most of this subregion are from the west. At the northern end, near Richmond, prevailing winds are from the south-southwest.

Temperatures in this subregion have a narrow range due to the proximity of the moderating marine air. Maximum temperatures in summer average in the mid-70's, with minimums in the mid-50's. Winter highs are in the mid- to high-50's, with lows in the low- to mid-40's.

The air pollution potential is lowest for the parts of the subregion that are closest to the bay, due largely to good ventilation and less influx of pollutants from upwind sources. The occurrence of light winds in the evenings and early mornings occasionally causes elevated pollutant levels. The air pollution potential at the northern (Richmond) and southern (Oakland, San Leandro) parts of this subregion is marginally higher than communities directly east of the Golden Gate, because of the lower frequency of strong winds.

This subregion contains a variety of industrial air pollution sources. Some industries are quite close to residential areas. The subregion is also traversed by frequently congested major freeways. Traffic and congestion, and the motor vehicle emissions they generate, are increasing.

Peninsula

The peninsula region extends from northwest of San Jose to the Golden Gate. The Santa Cruz Mountains run up the center of the peninsula, with elevations exceeding 2000 feet at the southern end, decreasing to 500 feet in South San Francisco. Coastal towns experience a high incidence of cool, foggy weather in the summer. Cities in the southeastern peninsula experience warmer temperatures and fewer foggy days because the marine layer is blocked by the ridgeline to the west. San Francisco lies at the northern end of the peninsula. Because most of San Francisco's topography is below 200 feet, marine air is able to flow easily across most of the city, making its climate cool and windy.

The blocking effect of the Santa Cruz Mountains results in variations in summertime maximum temperatures in different parts of the peninsula. For example, in coastal areas and San Francisco the mean maximum summer temperatures are in the mid-60's, while in Redwood City the mean maximum summer temperatures are in the low-80's. Mean minimum temperatures during the winter months are in the high-30's to low-40's on the eastern side of the Peninsula and in the low 40's on the coast..

Two important gaps in the Santa Cruz Mountains occur on the peninsula. The larger of the two is the San Bruno Gap, extending from Fort Funston on the ocean to the San Francisco Airport. Because the gap is oriented in the same northwest to southeast direction as the prevailing winds, and because the elevations along the gap are under 200 feet, marine air is easily able to penetrate into the bay. The other gap is the Crystal Springs Gap, between Half Moon Bay and San Carlos. As the sea breeze strengthens on summer afternoons, the gap permits maritime air to pass across the mountains, and its cooling effect is commonly seen from San Mateo to Redwood City.

Annual average wind speeds range from 5 to 10 mph throughout the peninsula, with higher wind speeds usually found along the coast. However, winds on the eastern side of the peninsula are often high in certain areas, such as near the San Bruno Gap and the Crystal Springs Gap.

The prevailing winds along the peninsula's coast are from the west, although individual sites can show significant differences. For example, Fort Funston in western San Francisco shows a southwest wind pattern while Pillar Point in San Mateo County shows a northwest wind pattern. On the east side of the mountains winds are generally from the west, although wind patterns in this area are often influenced greatly by local topographic features.

Air pollution potential is highest along the southeastern portion of the peninsula. This is the area most protected from the high winds and fog of the marine layer. Pollutant transport from upwind sites is common. In the southeastern portion of the peninsula, air pollutant emissions are relatively high due to motor vehicle traffic as well as stationary sources. At the northern end of the peninsula in San Francisco, pollutant emissions are high, especially from motor vehicle congestion. Localized pollutants, such as carbon monoxide, can build up in "urban canyons". However, winds are generally fast enough to carry the pollutants away before they can accumulate.

Santa Clara Valley

The Santa Clara Valley is bounded by the San Francisco Bay to the north and by mountains to the east, south and west. Temperatures are warm on summer days and cool on summer nights, and winter temperatures are fairly mild. At the northern end of the valley, mean maximum temperatures are in the low-80's during the summer and the high-50's during the winter, and mean minimum temperatures range from the high-50's in the summer to the low-40's in the winter. Further inland, where the moderating effect of the bay is not as strong, temperature extremes are greater. For example, in San Martin, located 27 miles south of the San Jose Airport, temperatures can be more than 10 degrees warmer on summer afternoons and more than 10 degrees cooler on winter nights.

Winds in the valley are greatly influenced by the terrain, resulting in a prevailing flow that roughly parallels the valley's northwest-southeast axis. A north-northwesterly sea breeze flows through the valley during the afternoon and early evening, and a light south-southeasterly drainage flow occurs during the late evening and early morning. In the summer the southern end of the valley sometimes becomes a "convergence zone," when air flowing from the Monterey Bay gets channeled northward into the southern end of the valley and meets with the prevailing north-northwesterly winds.

Wind speeds are greatest in the spring and summer and weakest in the fall and winter. Nighttime and early morning hours frequently have calm winds in all seasons, while summer afternoons and evenings are quite breezy. Strong winds are rare, associated mostly with the occasional winter storm.

The air pollution potential of the Santa Clara Valley is high. High summer temperatures, stable air and mountains surrounding the valley combine to promote ozone formation. In addition to the many local sources of pollution, ozone precursors from San Francisco, San Mateo and Alameda Counties are carried by prevailing winds to the Santa Clara Valley. The valley tends to channel pollutants to the southeast. In addition, on summer days with low level inversions, ozone can be recirculated by southerly drainage flows in the late evening and early morning and

by the prevailing northwesterlies in the afternoon. A similar recirculation pattern occurs in the winter, affecting levels of carbon monoxide and particulate matter. This movement of the air up and down the valley increases the impact of the pollutants significantly.

Pollution sources are plentiful and complex in this subregion. The Santa Clara Valley has a high concentration of industry at the northern end, in the Silicon Valley. Some of these industries are sources of air toxics as well as criteria pollutants. In addition, Santa Clara Valley's large population and many work-site destinations generate the highest mobile source emissions of any subregion in the Bay Area.

Sonoma Valley

The Sonoma Valley is west of the Napa Valley. It is separated from the Napa Valley and from the Cotati and Petaluma Valleys by mountains. The Sonoma Valley is long and narrow, approximately 5 miles wide at its southern end and less than a mile wide at the northern end.

The climate is similar to that of the Napa Valley, with the same basic wind characteristics. The strongest upvalley winds occur in the afternoon during the summer and the strongest downvalley winds occur during clear, calm winter nights. Prevailing winds follow the axis of the valley, northwest/southeast, while some upslope flow during the day and downslope flow during the night occurs near the base of the mountains. Summer average maximum temperatures are usually in the high-80's, and summer minimums are around 50 degrees. Winter maximums are in the high-50's to the mid-60's, with minimums ranging from the mid-30's to low-40's.

As in the Napa Valley, the air pollution potential of the Sonoma Valley could be high if there were significant sources of pollution nearby. Prevailing winds can transport locally and non-locally generated pollutants northward into the narrow valley, which often traps and concentrates the pollutants under stable conditions. The local upslope and downslope flows set up by the surrounding mountains may also recirculate pollutants.

However, local sources of air pollution are minor. With the exception of some processing of agricultural goods, such as wine and cheese manufacturing, there is little industry in this valley. Increases in motor vehicle emissions and woodsmoke emissions from stoves and fireplaces may increase pollution as the valley grows in population and as a tourist attraction.

Southwestern Alameda County

This subregion encompasses the southeast side of San Francisco Bay, from Dublin Canyon to north of Milpitas. The subregion is bordered on the east by the East Bay hills and on the west by the bay. Most of the area is flat.

This subregion is indirectly affected by marine air flow. Marine air entering through the Golden Gate is blocked by the East Bay hills, forcing the air to diverge into northerly and southerly paths. The southern flow is directed down the bay, parallel to the hills, where it eventually passes over southwestern Alameda County. These sea breezes are strongest in the afternoon. The further from the ocean the marine air travels, however, the ocean's effect is diminished.

Thus, although the climate in this region is affected by sea breezes, it is affected less so than the regions closer to the Golden Gate.

The climate of southwestern Alameda County is also affected by its close proximity to San Francisco Bay. The bay cools the air with which it comes in contact during warm weather, while during cold weather the bay warms the air. The normal northwest wind pattern carries this air onshore. Bay breezes push cool air onshore during the daytime and draw air from the land offshore at night.

Winds are predominantly out of the northwest during the summer months. In the winter, winds are equally likely to be from the east. Easterly-southeasterly surface flow into southern Alameda County passes through three major gaps: Hayward/Dublin Canyon, Niles Canyon and Mission Pass. Areas north of the gaps experience winds from the southeast, while areas south of the gaps experience winds from the northeast. Wind speeds are moderate in this subregion, with annual average wind speeds close to the bay at about 7 mph, while further inland they average 6 mph.

Air temperatures are moderated by the subregion's proximity to the bay and to the sea breeze. Temperatures are slightly cooler in the winter and slightly warmer in the summer than East Bay cities to the north. During the summer months, average maximum temperatures are in the mid-70's. Average maximum winter temperatures are in the high-50's to low-60's. Average minimum temperatures are in the low 40's in winter and mid-50's in the summer.

Pollution potential is relatively high in this subregion during the summer and fall. When high pressure dominates, low mixing depths and bay and ocean wind patterns can concentrate and carry pollutants from other cities to this area, adding to the locally emitted pollutant mix. The polluted air is then pushed up against the East Bay hills. In the wintertime, the air pollution potential in southwestern Alameda county is moderate. Air pollution sources include light and heavy industry, and motor vehicles. Increasing motor vehicle traffic and congestion in the subregion may increase Southwest Alameda County pollution as well as that of its neighboring subregions.

APPENDIX E - TOXIC AIR CONTAMINANTS

Introduction

Toxic air contaminants (TACs) are air pollutants which may lead to serious illness or increased mortality, even when present in relatively low concentrations. Potential human health effects of TACs include birth defects, neurological damage, cancer and death. There are hundreds of different types of TACs, with varying degrees of toxicity. TACs may be produced by a variety of sources, including industrial facilities such as refineries, chemical plants and chrome platers, commercial facilities such as dry cleaners and gasoline stations, and motor vehicles.

District Programs

The District has regulated TACs since the 1980's as a complement to the traditional efforts to reduce emissions of criteria air pollutants. To date, the District's air toxics program has been a risk-based approach, meaning that the decisions over what sources and pollutants to control and the degree to which to control them have been based on the results of health risk assessment. A health risk assessment is an analysis where human health exposure to toxic substances is estimated, and then considered together with information regarding the toxic potency of the substances, to provide quantitative estimates of health risks. (The risk assessments used by the District do not address the possibility of, or adverse health effects resulting from, accidental releases of toxic materials such as a fire or major spill. Review of industry's preparation for, and protection from, accidental releases is performed by emergency response agencies, such as local fire and health departments.) The District's air toxics program consists of three major elements: a program to control emissions from new and modified sources; and two programs directed at existing sources - one with retrofit requirements for categories of sources, and another which is based on facility-specific analyses.

Air Toxics New Source Review

The District reviews new and modified source permit applications in accordance with the District's Risk Management Policy (adopted by the District Board of Directors in 1987). The goal of the program is to prevent any proposed stationary sources from creating new air toxics problems. In addition, benefits are realized when older, more highly polluting sources are replaced with new sources that must meet more stringent control requirements.

The need for, and degree of, emissions control required in toxics new source review is based on the results of health risk screening analysis or health risk assessment. All new/modified permit applications are reviewed for potential health impacts. If any TACs are emitted in amounts that exceed de minimus levels, a risk screening analysis, using computer-modeled estimates of atmospheric dispersion, is completed by District staff. Table E-1 lists the pollutants that trigger the District's risk screening requirements. A project that passes this risk screen is judged to have an insignificant impact on public health. A project that fails the screen does not necessarily have a significant impact, but requires further review. Further review usually consists of more detailed dispersion modeling (including the use of actual meteorological data when applicable), and consideration of other site-specific factors.

TABLE E-1
POLLUTANTS THAT TRIGGER DISTRICT RISK SCREENING REQUIREMENTS

Carcinogenic Compounds		
Acetaldehyde	Dioxane, 1,4-	N-Nitrosodi-n-butylamine
Acrylamide	Epichlorohydrin	N-Nitrosomethylethylamine
Acrylonitrile	Ethylene dibromide	N-Nitrosodi-n-propylamine
Arsenic and arsenic compounds	(1,2-dibromoethane)	N-Nitrosopyrrolidine
Asbestos	Ethylene dichloride	PCBs
Benzene	(1,2-dichloroethane)	PAHs (including but not limited to):
Benzidine and salts	Ethylene oxide	Benz(a)anthracene
Beryllium	Formaldehyde	Benzo(b)fluoroanthene
Bis(chloromethyl)ether	Hexachlorobenzene	Benzo(k)fluoroanthene
Butadiene, 1,3-	Hexachlorocyclohexanes	Benzo(a)pyrene
Cadmium and cadmium compounds	Hydrazine	Dibenz(a,h)anthracene
Carbon tetrachloride	Methylene chloride	Ideno(1,2,3-cd)pyrene
Chlorinated dibenzodioxins and dibenzofurans (TCDD and TCDF)	Methylene dianiline & chloride, 4,4'-	Perchloroethylene
	Nickel and nickel compounds	(tretrachloroethylene)
Chloroform	Nickel subsulfide	Propylene oxide
Chromium (hexavalent)	N-Nitrosodiethylamine	Trichloroethylene
Dichlorobenzene, 1,4-	N-Nitrosodimethylamine	Trichlorophenol, 2,4,6-
Dichlorobenzidine, 3,3'-	N-Nitrosodiphenylamine	Urethane
Diethylhexylphthalate (DEHP)		Vinyl chloride
Noncarcinogenic Compounds		
Acetone	Glycol ethers:	Methylethylketone (MEK)
Acrolein	2-ethoxyethanol (Cellosolve)	Methyl mercury
Ammonia	2-methoxymethanol (Methylcellosolve)	Methyl methacrylate
Benzyl chloride	2-butoxyethanol (Butylcellosolve)	N-Methylpyrrolidone
Bromine and compounds	Hexachlorocyclopentadiene	Naphthalene
Butyl alcohol, tert-	Hexane, n-	Nitrobenzene
Carbon disulfide	Hydrogen chloride	Phenol
Chlorine	Hydrogen cyanide	Phosgene
Chlorobenzene	Hydrogen fluoride	Phosphine
Chlorofluorocarbons	Hydrogen sulfide	Phosphorus (white)
Chloropicrin	Isocyanates:	Phthalic anhydride
Chloroprene	methylene-bis-phenyliso-cyanate	Selenium and compounds
Chlorotoluene	methyl isocyanate	Sodium Hydroxide
Cresol	toluene diisocyanate	Styrene monomer
Diethylaminoethanol	Isophorone	Tetrahydrofuran
Dimethylamine	Isopropyl alcohol	Toluene
Dimethyl phthalate	Lead, inorganic, and compounds	Trichlorobenzene, 1,2,4-
Dioctyl phthalate	Maleic anhydride	Tricholorethane, 1,1,1-; (see Methyl cloroform)
Ethyl alcohol (ethanol)	Manganese and compounds	
Ethyl acetate	Mercury and compounds	Vapam (Na diethyldithio-carbamate)
Ethyl benzene	Methyl alcohol (methanol)	
Ethyl chloride	Methyl bromide	Xylene
Freons; (see Chlorofluorocarbons)	Methyl chloroform (TCA)	Zinc and compounds

Where risks cannot be reduced below specified health-based significance levels, sources must use the Best Available Control Technology for Toxics, or "T-BACT". The significance level for T-BACT is an individual cancer risk of 1-in-one million, or an ambient concentration above a non-cancer reference exposure level. If the residual health risks, after controls are applied, result in risks that exceed higher significance levels established for the overall acceptability of a project, then other risk reduction measures may be required, or the permits for the proposed source(s) may be denied.

The program has resulted in T-BACT being implemented on a variety of the most significant sources of TACs in the Bay Area. The program also encourages sound land use planning in that, through the risk assessment process, control requirements for sources increase in relation to their proximity to downwind sources.

Retrofit Requirements for Categories of Existing Sources

The primary mechanism for the development of retrofit air toxics control measures in California has been through the Toxic Air Contaminant Act, also referred to as the Tanner Act, adopted by the State legislature in 1983. The Tanner Act establishes a process for the identification of TACs, and for the preparation of retrofit toxic control measures on a Statewide basis. TACs are identified in a scientific review process involving the Air Resources Board (ARB), the Office of Environmental Health Hazard Assessment, and an independent scientific review panel. Once a contaminant is identified as a TAC, control measures, called Airborne Toxic Control Measures (ATCMs), are developed by the ARB. The measures are implemented and enforced by the local air districts, which may adopt the ATCMs as established by ARB, or set more stringent standards.

As of February 1996, 19 compounds have been identified as TACs through the State's scientific review process, and eight statewide ATCMs have been adopted. The first six adopted ATCMs have been adopted into District Rules and have been fully implemented in the Bay Area. These include measures for chrome plating, cooling towers, commercial and hospital sterilizers, medical waste incinerators, paving operations that use serpentine materials, and gasoline stations. The two most recently adopted ATCMs have been adopted as District rules, but final compliance dates have not yet been reached (as of February 1996). These rules address secondary metal melting operations and perchloroethylene dry cleaners.

The District has accelerated the control of air toxics for existing air toxics by supplementing the ATCMs with rules developed locally. Examples of these rules include those covering aeration of contaminated soil and water, marine vessel loading and unloading, and the addition of more stringent requirements for gasoline stations.

In 1990, the federal Clean Air Act was amended creating an ambitious federal air toxics program. In 1992, the State legislature adopted AB 2728 to provide a legal framework for the integration of the existing air toxics programs in California with the new federal program. This legislation required ARB to designate the 189 substances that were listed as Hazardous Air Pollutants in the federal Clean Air Act as TACs without going through the scientific review process. The list of substances designated by the ARB as TACs (as of August 1995) is given in Table E-2.

TABLE E-2
SUBSTANCES DESIGNATED BY ARB AS TOXIC AIR CONTAMINANTS

Chemical Name	CAS No.	Chemical Name	CAS No.
Acetaldehyde	75070	Cresol(o)	95487
Acetamide	60355	Cresol(p)	106445
Acetonitrile	75058	Cresols/Cresylic acid	1319773
Acetophenone	98862	Cumene (Isopropylbenzene)	98828
Acetylaminofluorene(2)	53963	Cyanide Compounds[24]	----
Acrolein	107028	D(2,4), salts and esters	94757
Acrylamide	79061	DDE	3547044
Acrylic acid	79107	Diazomethane	334883
Acrylonitrile	107131	Dibenzofurans	132649
Allylchloride	107051	Dibromo-3-chloropropane(1,2)	96128
Aminobiphenyl(4)	92671	Dibutylphthalate	84742
Aniline	62533	Dichlorobenzene(1,4)(p)	106467
Anisidine(o)	90040	Dichlorobenzidene(3,3)	91941
Antimony Compounds	----	Dichloroethyl ether	
Arsenic Compounds		(Bis(2-chloroethyl)ether)	111444
(inorganic including arsine)	----	Dichloropropene(1,3)	542756
Asbestos	1332214	Dichlorvos	62737
Benzene	71432	Diethanolamine	111422
Benzidine	92875	Diethylaniline(N,N)	
Benzotrichloride	98077	(Dimethylaniline(N,N)	121697
Benzyl chloride	100447	Diethyl sulfate	64675
Beryllium Compounds	----	Dimethoxybenzidine(3,3')	1119904
Biphenyl	192524	Dimethyl aminoazobenzene	60117
Bis(2-ethylhexyl)phthalate (DEHP)	117817	Dimethyl Benzidine(3,3')	119937
Bis(chloromethyl)ether	542881	Dimethyl carbamoyl chloride	79447
Bromoform	75252	Dimethyl formamide	68122
Butadiene(1,3)	106990	Dimethyl hydrazine(1,1)	57147
Cadmium Compounds	----	Dimethyl phthalate	131113
Calcium cyanamide	156627	Dimethyl sulfate	77781
Caprolactam	105602	Dinitro-o-cresol(4,6), and salts	534521
Captan	133062	Dinitrophenol(2,4)	51285
Carbaryl	63252	Dintrotoluene(2,4)	121142
Carbon disulfide	75150	Dioxane(1,4)(1,4-Diethyleneoxide)	123911
Carbon tetrachloride	56235	Diphenylhydrazine(1,2)	122667
Carbonyl sulfide	463581	Epichlorohydrin	
Catechol	120809	(Chloro-2,3-epoxypropane(1))	106898
Chloramben	133904	Epoxybutane(1,2)(1,2-Butylene oxide)	106887
Chlordane	57749	Ethyl acrylate	140885
Chlorine	7782505	Ethyl benzene	100414
Chloroacetic acid	79118	Ethyl carbamate (Urethane)	51796
Chloroacetophenone(2)	532274	Ethyl chloride (Chloroethane)	75003
Chlorobenzene	108907	Ethylene dibromide (1,2-Dibromoethane)	106934
Chlorobenzilate	510156	Ethylene dichloride (1,2-Dichloroethane)	107062
Chloroform	67663	Ethylene glycol	107211
Chloromethyl methyl ether	107302	Ethylene imine (Aziridine)	151564
Chloroprene		Ethylene oxide	75218
(Neoprene;; 2-chloro-1,3-butadiene)	126998	Ethylene thiourea	96457
Chromium Compounds	----	Ethylidene dichloride	
Cobalt Compounds	----	(1,1-Dichloroethane)	75343
Coke Oven Emissions	----	Formaldehyde	50000
Cresol(m)	108394	Glycol ethers[25]	----

24 X'CN where X = H' or any other group where a formal dissociation may occur, for example KCN or $Ca(CN)_2$.

25 Includes mono- and di-ethers of ethylene glycol, diethylene glycol and triethylene glycol $R\text{-}(OCH_2CH_2)_n\text{-}OR'$ where: n = 1,2,or 3 - R = alkyl or aryl groups - R' = R, H, or group which, when removed, yield glycol ethers with the structure: $R\text{-}(OCH_2CH)_n\text{-}OH$. Polymers are excluded from the glycol category.

TABLE E-2 (CONTINUED)
SUBSTANCES DESIGNATED BY ARB AS TOXIC AIR CONTAMINANTS

Chemical Name	CAS No.	Chemical Name	CAS No.
Heptachlor	76448	Phenylenediamine(p)	106503
Hexachlorobenzene	118741	Phosgene	75445
Hexachlorobutadiene	87683	Phosphine	7803512
Hexachlorocyclopentadiene	77474	Phosphorus	7723140
Hexachloroethane	67721	Pthalic anhydride	85449
Hexamethylene-1,6-disocyanate	822060	Polychlorinated biphenyls (Arochlors)	1336363
Hexamethylphosphoramide	680319	Polycylic Organic Matter[26]	----
Hexane	110543	Propane sultone(1,3)	1120714
Hydrazine	302012	Propiolactone(beta)	57578
Hydrochloric acid	7647010	Propionaldehyde	123386
Hydrogen fluoride (Hydrofluoric acid)	7664393	Propoxur (Baygon)	114261
Hydroquinone	123319	Propylene dichloride	
Isophorone	78591	(1,2-Dichloropropane)	78875
Lead Compounds	----	Propylene oxide	75569
Lindane (all isomers)	58899	Propylenimine(1,2) (2-Methyl aziridine)	75558
Maleic anhydride	108316	Quinoline	91225
Manganese Compounds	----	Quinone (1,4-Cyclohexadienedione)	106514
Mercury Compounds	----	Radionuclides (including radon)[27]	----
Methanol	67561	Selenium Compounds	----
Methoxychlor	72435	Styrene	100425
Methyl bromide (Bromomethane)	74839	Styrene oxide	96093
Methyl chloride (Chloromethane)	74873	Tetrachlorodibenzo-p-dioxin(2,3,7,8)	1746016
Methyl chloroform (1,1,1-Trichloroethane)	71556	Tetrachloroethane(1,1,2,2)	79345
Methyl ethyl ketone (2-Butanone)	78933	Tetrachloroethylene (Perchloroethylene)	127184
Methyl hydrazine	03464	Titanium tetrachloride	7550450
Methyl iodide (Iodomethane)	74884	Toluene	108883
Methyl isobutyl ketone (Hexone)	108101	Toluene diamine(2,4)	
Methyl isocyanate	624839	(2,4-Diaminotoluene)	95807
Methyl methacrylate	80626	Toluene diisocyanate(2,4)	584849
Methyl tert butyl ether	1634044	Toluidine(o)	95534
Methylene bis(2-chloroaniline)(4,4)	101144	Toxaphene (Chlorinated camphene)	8001352
Methylene chloride (Dichloromethane)	75092	Trichlorobenzene(1,2,4)	120821
Methylene diphenyl diisocynate (MDI)	101688	Trichloroethane(1,1,2,)	79005
Methylenedianiline(4,4')	101779	Trichloroethylene	79016
Mineral fibers[28]	----	Trichlorophenol(2,4,5)	95954
Naphthalene	91203	Trichlorophenol(2,4,6)	88062
Nickel Compounds	----	Triethylamine	121448
Nitrobenzene	98953	Trifluralin	1582098
Nitrobiphenyl(4)	92933	Trimethylpentane(2,2,4)	540841
Nitrophenol(4)	100027	Vinyl acetate	108054
Nitropropane(2)	79469	Vinyl bromide	593602
Nitroso-N-methylurea(N)	684935	Vinyl chloride	75014
Nitrosodimethylamine(N)	62759	Vinylidene chloride	
Nitrosomorpholine(N)	59892	(1,1-Dichloroethylene)	75354
Parathion	56382	Xylene(m)	108383
Pentachloronitrobenzene(Quintobenzene)	82688	Xylene(o)	95476
Pentachlorophenol	87865	Xylene(p)	106423
Phenol	108952	Xylenes(mixed)	1330207

26 Include organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100°C.

27 A type of atom which spontaneously undergoes radioactive decay.

28 Includes glass microfibers, glass wool fibers, rock wool fibers, and slag wool fibers, each characterized as "respirable" (fiber diameter less than 3.5 micrometers and possessing an aspect ratio (fiber length divided by fiber diameter) greater than 3.

Because of the federal program, the primary source of new air toxics rules in the Bay Area has shifted from the ATCMs developed by ARB to the National Emission Standards for Hazardous Air Pollutants (NESHAPs), developed by the U.S. EPA. (These federal rules are also commonly referred to as MACT standards, because they reflect the Maximum Achievable Control Technology.) A large number of MACT standards are due to be promulgated on a schedule extending through the year 2000. AB 2728 requires the District to implement and enforce all MACT standards, or rules that are at least as stringent.

Air Toxics "Hot Spots" Program

Assembly Bill 2588, the Air Toxics "Hot Spots" Information and Assessment Act, was enacted by the State legislature in 1987. AB 2588 requires plants emitting TACs to prepare inventories of the toxic air emissions from their entire facility. Air districts are then required to prioritize these facilities based on the quantity and toxicity of these emissions, and their proximity to areas where the public may be exposed.

Each facility that is put into a "high priority" category as a result of this review is required to prepare a comprehensive facility-wide health risk assessment. AB 2588 requires that exposed individuals then be notified of any "significant health risks" identified in the health risk assessment. The health risk levels used for public notification in the "hot spots" program are set by each individual air district. In the Bay Area, the District used a maximum individual cancer risk of 10 in one million, or an ambient concentration above a non-cancer reference exposure level, as the threshold of notification.

The first cycle of the District's "hot spots" program was completed in 1991. Out of the 129 "high priority" facilities preparing risk assessments, 30 had risk levels that required public notification. The number of facilities with risks over the notification levels was reduced to 16 in 1992. As of 1995, the number of facilities requiring public notification was 5. These reductions were attributable to efforts to further reduce emissions and to further refine risk assessments. Through 1995, no new high priority facilities had been identified since the original prioritization.

As part of the "hot spots" program, the District also is focusing on "industry-wide" risk assessments, which AB 2588 provides for small businesses that operate in a similar manner. Under the industry-wide program, the District is responsible for the preparation of risk assessments and for performing public notification. Industry-wide studies for gasoline stations and dry cleaners are scheduled for completion in 1996.

In 1992, the State "hot spots" program was amended with the passage of SB 1731. This legislation requires facilities to implement measures to reduce risks below levels determined by the District to be significant within a certain time frame. In 1994, the District took its first regulatory action under SB 1731 with the adoption of a more stringent rule for perchloroethylene dry cleaners. The risk reduction requirements of SB 1731 were incorporated into this rule because many dry cleaners (and in particular those that are located in residential buildings) have been identified with lifetime cancer risks that exceed 100-in-one-million.

APPENDIX F - RESOURCE DOCUMENTS

There is a growing body of research concerning land use and design strategies to reduce automobile use. This appendix identifies selected resources that may be useful to Lead Agencies and other parties interested in pursuing such strategies. This is not intended to be a comprehensive list, but rather a good starting point for those interested in land use-related measures to reduce auto use. Interested parties are encouraged in particular to refer to the report prepared by JHK & Associates for the California Air Resources Board indicated below (Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emission: An Indirect Source Research Study). The report includes an annotated bibliography listing over 150 documents.

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APPENDIX G - GLOSSARY

Acid Deposition -- Conversion of sulfur oxide and nitrogen oxide emissions into acidic compounds which precipitate in rain, snow, fog, or dry particles.

Aerosol -- Particle of solid or liquid matter that can remain suspended in the air because of its small size (generally under one micron).

Air Quality Management District (AQMD) -- Local agency charged with controlling air pollution and attaining air quality standards. The Bay Area Air Quality Management District is the regional AQMD that includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo and Santa Clara Counties and the southern halves of Solano and Sonoma Counties.

Air Resources Board (ARB) -- The State of California agency responsible for air pollution control. Responsibilities include: establishing State ambient air quality standards, setting allowable emission levels for motor vehicles in California and oversight of local air quality management districts.

Area Sources -- Sources of air pollutants that individually emit relatively small quantities of air pollutants, but which cumulatively may emit large quantities of emissions. Examples include water heaters, lawn maintenance equipment and consumer products.

Authority to Construct (A/C) -- A preconstruction permit issued by the District. An A/C typically includes conditions which the applicant must incorporate into facility design, operations, etc. in order to comply with District regulations.

Best Available Control Technology (BACT) -- The most stringent emissions control that has been achieved in practice, identified in a state implementation plan, or found by the District to be technologically feasible and cost-effective for a given class of sources.

California Clean Air Act (CCAA) -- Legislation enacted in 1988 mandating a planning process to attain state ambient air quality standards.

CALINE -- A model developed by the Air Resources Board that calculates carbon monoxide concentrations resulting from motor vehicle use.

Carbon Monoxide (CO) -- A colorless, odorless, toxic gas produced by the incomplete combustion of carbon-containing substances. It is emitted in large quantities by exhaust of gasoline-powered vehicles.

Catalytic Converter -- An air pollution abatement device used primarily on motor vehicles. It removes organic contaminants by oxidizing them into carbon dioxide and water through chemical reaction. May convert nitrogen dioxide to nitrogen and oxygen, as well as promoting other similar reactions.

Chlorofluorocarbons (CFCs) -- A family of inert, nontoxic, and easily liquefied chemicals used in refrigeration, air conditioning, packaging, insulation, or as solvents and aerosol propellants.

CFCs drift into the upper atmosphere where their chlorine components destroy stratospheric ozone.

Clean Air Act (CAA) -- Long-standing federal legislation, last amended in 1990, that is the legal basis for the national clean air programs.

Cold Start -- Starting a motor vehicle after the engine has cooled. The duration of time after engine shut-off needed to produce a cold start is typically about an hour for a catalyst equipped vehicle and about four hours for a non-catalyst equipped vehicle.

Conformity -- A requirement in federal law and administrative practice that requires that projects will not be approved if they do not conform with the State Implementation Plan by: causing or contributing to an increase in air pollutant emissions, violating an air pollutant standard, or increasing the frequency of violations of an air pollutant standard.

Criteria Air Pollutants -- Air pollutants for which the federal or State government has established ambient air quality standards, or criteria, for outdoor concentration in order to protect public health. Criteria pollutants include: ozone, carbon monoxide, sulfur dioxide PM_{10} (previously total suspended particulate), nitrogen oxide, and lead.

EMFAC - The computer model developed by the California Air Resources Board to estimate composite on-road motor vehicle emission factors by vehicle class.

Emission Factor -- The amount of a specific pollutant emitted from a specified polluting source per unit quantity of material handled, processed, or burned.

Emission Inventory -- A list of air pollutants emitted into an area's atmosphere, in amounts (commonly tons) per day or year, by type of source.

Environmental Protection Agency (EPA) -- The federal agency responsible for control of air and water pollution, toxic substances, solid waste, and cleanup of contaminated sites.

Exceedance -- A monitored level of concentration of any air contaminant higher than national or state ambient air quality standards.

Hazardous Air Pollutants -- Air pollutants which are not covered by ambient air quality standards but which may reasonably be expected to cause or contribute to serious illness or death (see NESHAPs).

Health Risk Assessment -- An analysis where human exposure to toxic substances is estimated, and considered together with information regarding the toxic potency of the substances, to provide quantitative estimates of health risk.

Hot Spot -- A location where emissions from specific sources may expose individuals and population groups to elevated risks of adverse health effects and contribute to the cumulative health risks of emissions from other sources in the area.

Hot Start - Starting a motor vehicle while the engine is still fully warmed up.

Hydrocarbon -- Any of a vast family of compounds containing carbon and hydrogen in various combinations; found especially in fossil fuels. Some of the hydrocarbon compounds are major air pollutants; they may be active participants in the photochemical process or affect health.

Hydrogen Sulfide (H_2S) -- A gas characterized by "rotten egg" smell, found in the vicinity of oil refineries, chemical plants and sewage treatment plants.

Indirect Sources -- Land-uses and facilities which attract or generate motor vehicle trips and thus result in air pollutant emissions, e.g., shopping centers, office buildings, and airports.

Inversion -- The phenomenon of a layer of warm air over cooler air below. A special problem in polluted areas because this atmospheric structure resists the natural dispersion and dilution of air contaminants.

Level of Service (LOS) -- A transportation planning term for a method of measurement of congestion. The LOS compares actual or projected traffic volume to the maximum capacity of the road under study. LOS ranges from A through F. LOS A describes free flow conditions, while LOS F describes the most congested conditions, up to or over the maximum capacity for which the road was designed.

Mixing Depth -- The expanse in which air rises from the earth and mixes with the air above it until it meets air equal or warmer in temperature -- the inversion cap.

Mobile Source -- Any vehicle that produces air pollution, such as cars, trucks and motorcycles (on road mobile sources) or airplanes, trains and construction equipment (off-road mobile sources).

National Ambient Air Quality Standards (NAAQS) -- Health-based pollutant concentration limits established by EPA that apply to outside air (see Criteria Air Pollutants).

National Emissions Standards for Hazardous Air Pollutants (NESHAPs) -- Emissions standards set by EPA for air pollutants not covered by NAAQS that may cause an increase in deaths or in serious, irreversible, or incapacitating illness.

Nitrogen Oxides (NOx) -- Gases formed in great part from atmospheric nitrogen and oxygen when combustion takes place under conditions of high temperature and high pressure; NOx is a criteria air pollutant.

Non-Attainment Area -- Defined geographic area that does not meet one or more of the Ambient Air Quality Standards for the criteria pollutants designated in the federal Clean Air Act and/or California Clean Air Act.

Organic Compounds -- Large group of chemical compounds that contain carbon. Some types of organic gases, including olefins, aromatics and aldehydes, are highly reactive -- that is, participate in photochemical reactions in the atmosphere to form oxidant.

Ozone (0_3) -- A pungent, colorless, toxic gas. A product of complex photochemical processes, usually in the presence of sunlight. Tropospheric (lower atmosphere) ozone is a criteria air pollutant.

Ozone Depletion -- Destruction of the stratospheric ozone layer (10 to 20 miles above the earth) which shields the earth from ultraviolet radiation. This destruction is caused by the breakdown of certain chlorine and/or bromine-containing compounds (chlorofluorocarbons or halons).

Particulate -- A particle of solid or liquid matter; soot, dust, aerosols, fumes and mists.

Permit to Operate (P/O) -- An operational permit issued yearly by the Air District to industrial sources which emit air contaminants..

Photochemical Process -- The chemical changes brought about by the radiant energy of the sun acting upon various polluting substances. The products are known as photochemical smog.

Pollution Standards Index (PSI) -- A national, standardized system of reporting air pollution levels to the public by assigning them a numerical value.

PM_{10} -- Fine particulate matter (solid or liquid) with an aerodynamic diameter equal to or less than 10 microns. Individual particles of this size are small enough to be inhaled into human lungs; they are not visible to the human eye.

Precursor -- Compounds that change chemically or physically after being emitted into the air and eventually produce air pollutants. For example, organic compounds are precursors for ozone.

Prevention of Significant Deterioration (PSD) -- EPA program in which state and/or federal permits are required that are intended to restrict emissions for new or modified sources in places where air quality is already better than required to meet primary and secondary ambient air quality standards.

Reactive Organic Gases (ROG) -- Classes of organic compounds, especially olefins, substituted aromatics and aldehydes, that react more rapidly in the atmosphere to form photochemical smog or ozone.

Risk Management and Prevention Program (RMPP) -- A program enacted by the State Legislature in 1986 in order to reduce the risk of public exposure to acutely hazardous materials resulting from upsets at industrial and commercial facilities. RMPP analyses identify possible hazards at a facility, estimate potential consequences of an upset to public health and safety, address measures to reduce the chances of an upset, and identify measures for responding to accidents that may occur. The program is usually administered by the county health department or the local fire department.

Sensitive Receptors -- Facilities or land uses that include members of the population that are particularly sensitive to the effects of air pollutants, such as children, the elderly and people with illnesses. Examples include schools, hospitals and residential areas.

State Implementation Plan (SIP) -- EPA-approved state plans for attaining and maintaining federal air quality standards.

Stationary Source -- A fixed, non-mobile source of air pollution, usually at industrial or commercial facilities.

Sulfur Oxides (SO_x) -- Pungent, colorless gases formed primarily by the combustion of sulfur-containing fossil fuels, especially coal and oil. Considered a criteria air pollutant, sulfur oxides may damage the respiratory tract as well as vegetation.

Total Suspended Particulate Matter (TSP) -- Particles of solid or liquid matter -- soot, dust, aerosols, fumes and mist -- up to approximately 30 microns in size. As a criteria pollutant TSP has been replaced by PM_{10}.

Toxic Air Pollutants -- Air pollutants which cause illness or death in relatively small quantities. Non-criteria air contaminants that, upon exposure, ingestion, inhalation, or assimilation into organisms either directly from the environment or indirectly by ingestion through food chains, will cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, or physical deformations in such organisms or their offspring.

Transportation Control Measures (TCMs) -- Measures to reduce congestion and decrease emissions from motor vehicles by reducing vehicle use.

URBEMIS - A computer model developed by the California Air Resources Board to estimate air pollutant emissions from motor vehicle trips associated with land use development.

Volatile Organic Compound (VOC) -- An organic compound that evaporates readily at normal temperatures; a precursor to ozone.

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BAY AREA AIR QUALITY MANAGEMENT DISTRICT

FOR A CLEANER, HEALTHIER

BAY AREA

The Bay Area Air Quality Management District (Air District) was created by the California Legislature in 1955 as the first regional agency in the state to deal with air pollution. The Air District was created as a regional agency because air pollution problems cross county lines; pollutants generated in one county are often transported to others. The Air District's jurisdiction includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma counties.

For more than forty years, the Air District has reduced air pollution in the Bay Area by limiting emissions from large manufacturing operations, refineries, chemical plants, gas stations, dry cleaners, and other stationary sources of air pollution. The Air District has also regulated agricultural open burning since 1957 and prohibited "backyard" burning since 1970. Because motor vehicles are now the largest source of air pollution in the Bay Area, more recent Air District efforts have focused on reducing motor vehicle pollution and residential sources of air pollution through the voluntary programs *Don't Light Tonight* and *Spare the Air*.

WORKING FOR CLEANER AIR

Air District Operations

The Air District takes a multi-faceted approach to reducing air pollution in the Bay Area through its permit program, regulations, enforcement procedures and public outreach campaign. The Air District has seven divisions — Enforcement, Permit Services, Technical Services, Planning, Legal, Administration, and Public Information and Education — which together work to bring the Bay Area into attainment of the state and national air quality standards.

Control at the Source

Any facility within the Air District's jurisdiction having the potential to emit air pollutants must obtain permits to both construct and operate within the Bay Area. Through the permit process, Air District engineers evaluate sources of air pollution at a facility and may require the installation of emission abatement equipment before the facility is allowed to operate. Once issued, permits are reviewed annually.

Regulation and Enforcement

Air District staff are continually developing new rules and refining existing rules to further reduce air pollution emissions in the Bay Area. Any proposed rules or rule changes undergo a formal workshop process prior to being heard by the Board of Directors.

The Air District's Inspection Section is responsible for ensuring that each facility complies with Air District rules and regulations as well as with any applicable permit conditions for that facility. Each facility is inspected regularly, and if non-compliance is found, a violation notice is issued. Inspection staff also respond to citizen complaints about odors and other air quality problems or incidents.

How Our Programs and Regulations are Established

Federal Requirements

The Air District's programs and regulations are driven by both state and federal requirements. At the federal level, the U.S. Environmental Protection Agency has set national health-based air quality standards for some of the most common air pollutants — ozone, carbon monoxide, sulfur dioxide, nitrogen oxides and particulate matter. Each state is required to submit a plan to EPA outlining how the state will comply with the national standards. EPA has also set specific requirements for a number of air pollution control programs, including those for permitting, Smog Check and hazardous air pollutants.

State Air Quality Programs

At the state level, two agencies influence the Air District's activities — the California Environmental Protection Agency (Cal-EPA) and the California Air Resources Board (CARB). CARB focuses largely on motor vehicle emission standards and other mobile source programs, including Smog Check and reformulated fuels, while Cal-EPA's role in air quality is primarily to oversee CARB's activities.

In 1988, the California Clean Air Act was enacted, requiring local districts to meet California's air quality standards, including those for ozone and carbon monoxide. (For ground-level ozone, the state standard is much more stringent than the national standard.) In response, each air district has developed and submitted to CARB an air quality plan showing what control meaures will be implemented to achieve the state standards. CARB oversees the stationary source programs of local air districts, and any amended or newly adopted rules or regulations must be approved by CARB as well as by the EPA.

How the Air District is Organized

Board of Directors

The Air District's activities are governed by a 20-member *Board of Directors* comprised of locally elected officials from each of the nine Bay Area counties. The number of county supervisors, mayors or city councilpersons serving on the Board is determined by the size of the county represented.

The Board of Directors formulates policies and adopts regulations to control sources of air pollution within the District. Prior to adopting or amending any District rule, the Board holds a public hearing to invite formal input from the public and affected industries. All rules and regulations must be adopted by a majority of the Directors. The Board also appoints the Air Pollution Control Officer (APCO), who heads the staff at the Bay Area Air Quality Management District, as well as the District Counsel and the Clerk of the Boards.

Advisory Council and Hearing Board

The *Advisory Council* is made up of 20 representatives from community, health and environmental organizations, as required by state law. The Council advises the Board and the APCO on technical and policy matters.

The *Hearing Board* is a five-member quasi-judicial body that hears appeals from the regulated community for variances from District regulations, permit conditions or permit decisions. Variances, if granted, are for a specified period of time. When a facility receives repeated violation notices or complaints, the Air District may ask the Hearing Board to order the company to comply with the law. Violations of Hearing Board orders are subject to penalties of up to $25,000 per day and are enforceable through superior court.

Data Gathering and Air Quality Forecasting

Twenty-eight air monitoring stations throughout the Bay Area track pollutant levels 24 hours a day, seven days a week. Staff meteorologists use this data along with weather information to forecast daily air quality readings. Each day at 4 p.m., current air quality readings and the forecast for the following day are made available on the Air District's 1 (800) HELP-AIR line.

Planning for the Future

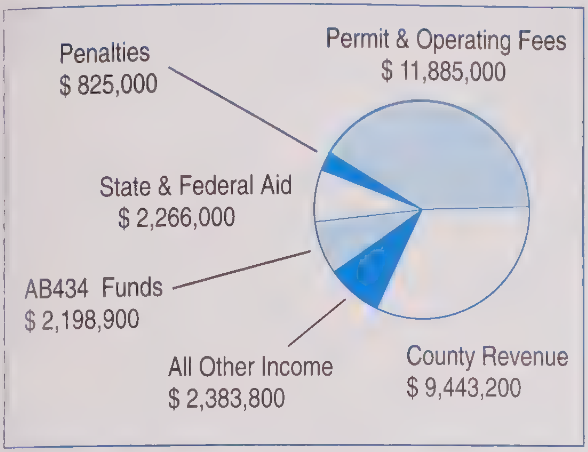
The Air District periodically prepares and updates plans to achieve the goal of healthy air. Emissions inventories from industry, motor vehicle and population growth statistics and air monitoring data are used to assess progress and plan future strategies to achieve and maintain air quality standards.

Public Information and Education

An integral part of reducing air pollution in the Bay Area involves forming partnerships with the public and with Bay Area businesses to work on solutions to air quality problems. To assist in this effort, the Public Information Office responds to inquiries from the public and the media, provides free air quality literature, and provides speakers for air quality talks and environmental fairs. Grass-roots resource teams help the Air District spread the clean-air message on the local level. The Public Information Office is also responsible for issuing *Spare the Air* and *Don't Light Tonight* requests to Bay Area media and to the public via the District's 1 (800) HELP-AIR line and its *Spare the Air* website (*http://www.sparetheair.org/*) when air pollution is approaching unhealthy levels. Hundreds of Bay Area employers also participate in these programs, educating and notifying their employees of *Spare the Air* and *Don't Light Tonight* requests.

How We Are Funded

The Air District's activities are funded through a variety of sources, as shown in the chart below. For fiscal year 1996-97, the Air District is staffed with 318 employees and has an operating budget of $29 million.



Clean Air Progress in the Bay Area

Over the last several decades, the District's controls on stationary sources, along with CARB's mobile source controls, have significantly improved air quality in the Bay Area. In fact, in June of 1995, the Bay Area was officially designated an attainment area for the national ozone standard, making it the largest metropolitan area in the country to achieve this goal. However, more remains to be done if the Bay Area is to meet the more stringent state ozone standard and provide clean, healthy air for all Bay Area residents. Call 1 (800) HELP-AIR for information on how you can help clean the air.

BAY AREA AIR QUALITY
MANAGEMENT DISTRICT
(415) 771-6000
939 Ellis Street, San Francisco, CA 94109-7714

Daily Forecasts
1 (800) HELP AIR

Air Pollution Complaints
1 (800) 334-ODOR

Report Smoking Vehicles
1 (800) EXHAUST

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